



August 16, 2006

Mr. Devender Narala
Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, CA 94612

**RE: Redlined Recommended Final Corrective Action Plan; Building 1065 Area
Presidio of San Francisco, California**

Dear Mr. Narala:

The Presidio Trust (Trust) is pleased to provide the enclosed copy of the *Redlined Recommended Final Corrective Action Plan, Building 1065 Area, Presidio of San Francisco, California*, dated August 16, 2006 for your review and concurrence. Upon California Regional Water Quality Control Board (Water Board) concurrence on the enclosed document, the Trust will submit the signed final CAP (without redlines) for official Water Board approval.

The Trust's original Draft CAP for the Building 1065 Area site was dated June 29, 2005. The Water Board commented on the Draft CAP by letter dated November 14, 2005. The enclosed recommended final CAP is presented in redlined format so changes from the Draft CAP are readily apparent. The enclosed text and tables of the CAP have been reproduced in their entirety; but only revised plates and revised appendices are being provided for your review. The Draft CAP has been revised to:

1. Respond to Water Board comments on the Draft CAP;
2. Document that Remedial Unit B (RU-B) is being addressed in the Remedial Action Plan for Fill Site 6B;
3. Incorporate conclusions and recommendations from a recent study of arsenic in groundwater at the Building 1065 Area and two adjacent CAP sites (Arsenic Study).
4. Include recent updates to the Presidio Trust Land Use Control Master Reference Report.

This submittal includes the following:

- Revised text – changes are shown in tracked changes (redline-strikeout)
- All main text tables including the tables that have been revised as itemized below:
 - Table 3 – *Summary of Chemicals and Applicable Groundwater Cleanup Levels – 2004 Groundwater Monitoring Data* - changes are shown in redline
 - Table 7 – *Summary of the Evaluation of Corrective Action Alternatives* - changes are shown in redline
 - Table 8 – *Summary of Corrective Action Alternative Selection* - changes are shown in redline
 - Table 9 – *Groundwater Monitoring Program* - changes are shown in redline

- Revised Plates
 - Plate 1 – *Site Location Map*
 - Plate 14 – *Soil Remedial Units*
 - Plate 16 – *Proposed Land Use Control Areas, Excavation Areas, and Groundwater Monitoring Wells*
- Appendix A – *Responsiveness Summary – Comments and Responses*
- Appendix B, Table B-5 – *Laboratory Qualifiers* - new table
- Appendix D, Table D-18 – *Abbreviations, Laboratory Qualifiers and Comments* – new table
- Appendix F – *Cost Estimates and Assumptions for Corrective Action Alternatives*.

Once we receive Water Board concurrence on the enclosed recommended Final CAP, the Trust will submit the final CAP (without redlines) for official Water Board approval.

Please contact me at (415) 561-4259 if you have any questions.

Sincerely yours,
The Presidio Trust

A handwritten signature in black ink that reads "Craig Cooper". The signature is fluid and cursive, with the first name "Craig" and last name "Cooper" clearly distinguishable.

Craig Cooper
Remediation Program Manager

Enclosure

Cc Brian Ullensvang, National Park Service (NPS)
 Bob Boggs, Department of Toxic Substances Control (DTSC)
 Doug Kern, Restoration Advisory Board (RAB)
 Mark Youngkin, RAB [Without Enclosure]

**REDLINED RECOMMENDED FINAL
CORRECTIVE ACTION PLAN
BUILDING 1065 AREA
PRESIDIO OF SAN FRANCISCO, CALIFORNIA**



August 16, 2006



Draft

**Corrective Action Plan
Building 1065 Area
Presidio of San Francisco, California**

Prepared for

The Presidio Trust

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August 16, 2006



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Draft

**Corrective Action Plan
Building 1065 Area
Presidio of San Francisco, California**

MACTEC Project No. 4089030004 ~~00173~~00112

This document was prepared by MACTEC Engineering and Consulting, Inc. (MACTEC) at the direction of the Presidio Trust (Trust) for the sole use of the Trust, the National Park Service (NPS), and regulatory agencies, the only intended beneficiaries of this work. No other party should rely on the information contained herein without the prior written consent of the Trust. This report and the interpretations, conclusions, and recommendations contained within are based, in part, on information presented in other documents that are cited in the text and listed in the references. Therefore, this report is subject to the limitations and qualifications presented in the referenced documents.

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- B GROUNDWATER MONITORING DATA
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- E RATIONALE FOR USE OF RBSL FOR MIBK AS A SURROGATE FOR 2-HEXANONE
- F COST ESTIMATES AND ASSUMPTIONS FOR CORRECTIVE ACTION ALTERNATIVES

DISTRIBUTION

ACRONYMS AND ABBREVIATIONS

AHPA	Archaeological and Historic preservation Act
Army	United States Department of the Army
AST	aboveground storage tank
BAAQMD	Bay Area Quality Management District
BBL	Blasland, Bouck, & Lee, Inc.
bgs	below ground surface
BRAC	Base Realignment and Closure
BTEX	benzene, toluene, ethylbenzene, and xylenes
C	carbon
Cal/EPA	California Environmental Protection Agency-DTSC
CAP	Corrective Action Plan
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESA	California Endangered Species Act
Cleanup Level Document	Development of Presidio-wide Cleanup Levels for Soil, Sediment, Groundwater and Surface Water
COC	chemical of concern
CSFDEH	City of San Francisco Department of Environmental Health
cy	cubic yards
D&M	Dames & Moore
1,2-DCA	1,2-dichloroethane
1,2-DCB	1,2-dichlorobenzene
1,3-DCB	1,3-dichlorobenzene
1,4-DCB	1,4-dichlorobenzene
cis-1,2-DCE	cis-1,2-dichloroethene
DO	dissolved oxygen
DTSC	Department of Toxic Substance Control
ECC	Environmental Chemical Corporation
EKI	Erler & Kalinowski, Inc.
EM	electromagnetic
ESA	Endangered species act
ESL	Environmental screening level
FDS	fuel distribution system
FEPZ	freshwater ecological zone
FPALDR	Fuel Product Line Action Level Development Report
ft/ft	feet per foot
GGNRA	Golden Gate National Recreation Area
GIS	Geographic information system
GMPA	General Management Plan Amendment
GPR	ground penetrating radar
GRU	groundwater remedial unit
IT	IT Corporation
LTTD	Low temperature thermal desorption
LUC	land use control
LUCMRP	Presidio Trust Land Use Control Master Reference Report
MACTEC	MACTEC Engineering and Consulting, Inc.

MAG	magnetics
MBTA	Migratory Bird Treaty Act
MCLs	maximum contaminant <u>level</u> limits
mg/L	milligrams per liter
mg/kg	milligrams per kilogram
MOA	Memorandum of Agreement
MtBE	methyl-tert butyl ether
MW	Montgomery Watson
NA GPRA	Native American Gravel Protection and Repatriation Act
NEPA	National Environmental Policy Act
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NPS	National Park Service
O&M	operations and maintenance
ORC [®]	Oxygen Releasing Compound [®]
ORP	<u>oxidation-reduction potential</u>
PAHs	polynuclear aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
PCE	tetrachloroethene
PCP	Petroleum Contingency Plan
pH	corrosivity
Phase I IA	Phase I Interim Action
PID	Photo-ionization detector
PLLW	Presidio Lower Low Water Datum of 1907
POCC	point of compliance concentration
ppm	Parts per million
Presidio	Presidio of San Francisco
PTMP	Presidio Trust Management Plan
QA/QC	quality assurance/quality control
QM	Quartermaster
RAB	Presidio Restoration Advisory Board
RAO	Remedial Action Objective
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
Redox	<u>oxidation-reduction potential</u>
RI	Remedial Investigation
RU	remedial unit
RWQCB	Regional Water Quality Control Board
RWQCB Order	RWQCB Order No. R2-2003-0080
SCRs	Site Cleanup Requirements
sf	square feet
SFDPH	San Francisco Department of Public Health
SFFD	San Francisco Fire Department
the site	Building 1065 Area
SRU	<u>soil remedial unit</u>
SVE	soil vapor extraction
SVOCs	semi-volatile organic compounds
T&R	Treadwell & Rollo
1,1,1-TCA	1,1,1-trichloroethane
1,1,2-TCA	1,1,2-trichloroethane
TCDD-TE	2, 3, 7, 8-tetrachlorodibenzo-p-dioxin-toxicity equivalent

TCE	trichloroethene
TDS	total dissolved solids
TOC	total organic carbon
TPH	total petroleum hydrocarbon
TPHd	total petroleum hydrocarbon as diesel
TPHfo	total petroleum hydrocarbon as fuel oil
TPHg	total petroleum hydrocarbon as gasoline
TPHmo	total petroleum hydrocarbon as motor oil
TPHss	total petroleum hydrocarbon as Stoddard solvent
the Trust	Presidio Trust
Trust Act	Section 103 of the Omnibus Parks and Public Land Management Act of 1996, Public Law 104-33, 110 STAT. 4097
µg/L	micrograms per liter
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOCs	volatile organic compounds
XRF	x-ray fluorescence

EXECUTIVE SUMMARY

This Corrective Action Plan (CAP) has been prepared to evaluate and select corrective action alternatives to address soil and groundwater contamination at the Building 1065 Area, Presidio of San Francisco, California (the site). This CAP addresses contamination that is related to or co-located with releases of petroleum hydrocarbons from past use of the site.

Site History and Planned Land Use

The site, which is located in the northeast portion of the Presidio of San Francisco (Presidio), was historically used for vehicle maintenance, and contained a service/gas station, garage, laundry with dry cleaning facility, crematory, paint shop, power house/steam plant, fuel oil storage, and fuel oil distribution lines, occupational therapy building, warehouses, isolation ward and prison, wagon shed, and an incinerator. The site consists of historical buildings, paved parking areas, roadways, and some landscaping. Planned use of the Building 1065 Area includes institutional use in the southwestern portion of the site and commercial and recreational use for the remainder of the site. A historical building at the site (Building 1063) and the area to the south are planned to be used to house a recycled water treatment plant with a below grade water storage tank. In addition, west of the site is the planned location of the Tennessee Hollow riparian corridor.

Previous Investigations and Corrective Actions

Previous investigations conducted by the United States Army (Army) consisted of a Preliminary Assessment, Site Investigation, Remedial Investigation (RI), and a draft CAP. The Presidio Trust (Trust) conducted a site characterization investigation to address data gaps identified from review of results of previous investigations, and an additional investigation at Building 1063, and has been conducting a quarterly groundwater monitoring program at the site. Previous corrective actions included removal of aboveground storage tanks (ASTs), underground storage tanks (USTs), fuel distribution system (FDS) lines, and a Phase I interim action (Phase I IA) excavation in the area of the proposed water treatment plant below-grade water storage tank. Previous corrective actions included the following:

Army Corrective Actions (1993-1996)

- Removal of Building 1027 UST
- FDS Removal (Edie and Girard Roads; [FDS line segments BR8-1, BR16-1, and BR10-3](#))
- Removal of Water Storage Tanks 1047.1, 1047.2, and 1047.3
- Removal of ASTs 1040.1 & 1040.2 and Associated Distribution Lines
- Removal of USTs 1065.1, 1065.2, 1065.3.

Trust Corrective Actions (2002-2004)

- Cleaning of Building 1047 Hydraulic Storage Tank and Elevator Pit
- Removal of Building 1062 Hot/Well Sump
- Removal of UST 1047.4

- Phase I IA
- Removal of UST 1065.4
- Birmingham Road FDS Line Removal.

Geologic and Hydrogeologic Conditions

Previous investigations show that the upper units comprise fill and shallow sand which are underlain by Bay Mud in the northern part of the site and a silt unit (likely Colma formation) in the southern part of the site. The Bay Mud and silt units are underlain by silty sands identified as the intermediate/shallow sand, upper and lower intermediate sand.

Two primary hydrogeologic units have been identified at the site: a shallow groundwater zone and an intermediate groundwater zone. The shallow groundwater zone consists of saturated portions of the fill and, where present, the shallow sand. Groundwater in the shallow groundwater zone is unconfined and groundwater flow is to the northeast. The intermediate groundwater zone consists of the intermediate/shallow sand, upper intermediate sand, and lower intermediate sand. Groundwater in the intermediate zone is semiconfined and groundwater flow is generally to the north. There is an upward vertical gradient between the intermediate and shallow groundwater zones in the northern and central portions of the site.

Review of groundwater monitoring data shows that the Bay Mud and the upward vertical groundwater gradient have been effective in reducing the downward migration of chemical contaminants. It also appears that reducing conditions exist in the shallow groundwater zone in the northern part of the site where fill and the shallow sand are underlain by Bay Mud. Shallow groundwater in the southern part of the site and in the intermediate groundwater zone is appears to be reducing to slightly oxidizing. Redox conditions appear to have affected the relative solubility of metals in groundwater including arsenic, iron, and chromium. Arsenic and iron have been detected at higher concentrations in the shallow groundwater zone where reducing conditions exist, and chromium has been detected at higher concentrations in the shallow groundwater zone in the southern part of the site and in the intermediate groundwater zone.

Nature and Extent of Contamination

Data from previous investigations were evaluated with respect to applicable cleanup levels to identify areas where contaminants were present at levels that could potentially pose risk to human health, the environment, or drinking water quality. Based on this review, there are three areas where contaminants are present above cleanup levels – (1) Building 1063, (2) parking lot west of Building 1063, and (3) beneath the west side of Building 1040.

Soil beneath, north, and south of Building 1063 contains benzo(a)pyrene, total petroleum hydrocarbons as diesel (TPHd), total petroleum hydrocarbons as fuel oil (TPHfo), total petroleum hydrocarbons as gasoline (TPHg), 2-hexanone, benzene, ethylbenzene, toluene, lead, cadmium, and arsenic above cleanup levels. Contamination in this area is likely the downgradient extent of a contaminant plume that extended north (downgradient) of the former Building 1065 USTs. The petroleum hydrocarbons detected at this location could also be from past releases from the former FDS lines that ran east-west along Birmingham Road and also ran north-south between Buildings 1040 and 1063.

In the parking lot west of Building 1063, metals, TPHfo, TPHd, benzene, and benzo(a)pyrene were detected in soil at concentrations exceeding cleanup levels. Contamination did not appear to be at any specific horizon or location relative to identified potential source areas associated with past use of the site.

Petroleum hydrocarbons are likely from incidental spillage from vehicles parked or serviced in the area that may have been moved around and buried during demolition of buildings and re-grading of the site. Metals and polynuclear aromatic hydrocarbons (PAHs) released to surface soil could have been similarly redistributed in fill areas during site demolition and grading activities.

Beneath the west side of Building 1040, TPHfo and TPHd are present above cleanup levels in soil. Petroleum hydrocarbons detected in soil samples at this location may be from past leaks in the former FDS lines that entered the building or from the former fuel oil AST located immediately west of Building 1040.

Review of the ~~most recent (2004)~~ groundwater monitoring data and 2003 HydroPunch data shows that TPHg, benzene, antimony, and arsenic have been detected above cleanup levels in the shallow groundwater zone in the vicinity of Building 1063. Except for antimony, there have not been any cleanup level exceedances in samples collected from the intermediate groundwater zone. TPH and benzene, toluene, ethylbenzene, and xylenes (BTEX) detected in groundwater in the vicinity of Building 1063 are likely the downgradient end of a hydrocarbon plume originating from the former Building 1065 USTs. Groundwater monitoring data show that concentrations of TPHg and BTEX have declined over time and the decrease in concentrations are generally coincident with a decline in groundwater elevations observed at the site that was likely the result of excavation dewatering at a nearby construction site (T&R, 2003). Groundwater at the site was apparently being captured by the cone of depression created by the excavation dewatering. The decline in contaminant concentrations could be the result of water levels dropping below the smear zone, where petroleum hydrocarbons are adsorbed to soil particles, and/or movement of contaminated groundwater toward the cone of depression created by the excavation dewatering. This dewatering was conducted prior to implementation of the Phase I IA, in which contaminated soil was removed by excavation. Monitoring of a well (1065MW9A) downgradient of the Phase I IA excavation showed that TPHg and BTEX continued to remain nondetect or below cleanup levels following the Phase I IA excavation even after groundwater levels rose and groundwater flow resumed its normal pattern in response to cessation of the dewatering program. As a result, it appears that excavation of soil containing petroleum hydrocarbons was effective in reducing petroleum hydrocarbon concentrations in groundwater to below cleanup levels.

Chemicals of Concern

Based on the occurrence and concentrations of chemicals in soil and groundwater at concentrations exceeding cleanup levels, the following chemicals of concern (COCs) were identified for cleanup in soil:

- Petroleum hydrocarbons - TPHfo, TPHg, and TPHd;
- Volatile organic compounds (VOCs) – benzene, ethylbenzene, 2-hexanone, and toluene;
- PAHs – benzo(a)pyrene; and
- Metals – arsenic, cadmium, lead, and zinc.

The following COCs were identified for groundwater:

- TPHg;
- Benzene; and
- Arsenic.

Although antimony was detected above cleanup levels in groundwater at the site, it was not retained as a COC because it was only detected in HydroPunch samples in the vicinity of Building 1063 and has not been confirmed by samples collected from monitoring wells. Arsenic is believed to be present because of combination of locally reducing conditions in groundwater caused by degradation of organic matter in the underlying Bay Mud and/or degradation of petroleum hydrocarbons at or downgradient of a petroleum hydrocarbon release from former USTs at the site and a source of arsenic in the native sand or fill material in the shallow groundwater zone.

In 2006, the Trust conducted a study to further evaluate the presence of arsenic in groundwater and its relationship to petroleum hydrocarbons, soil types, and groundwater chemistry at the Building 1065 Area, and two neighboring CAP sites—the Building 207/231 Area and the Commissary/PX Area. The results of this study were published in the *Technical Memorandum, Evaluation of Arsenic and Other Metals in Groundwater at Three Corrective Action Plan Sites, Presidio of San Francisco (MACTEC, 2006)*. Based on results of the study, arsenic is believed to be present in groundwater at elevated concentrations at these sites primarily due to degradation of petroleum hydrocarbons in saturated soils at or downgradient of a petroleum hydrocarbon release (from former USTs at the Building 1065 Area). It appears that arsenic is being mobilized from its adsorbed state on the iron coatings of soil particles due to more strongly reducing conditions imposed by the biodegradation of petroleum hydrocarbons present in saturated soils where petroleum releases occurred. To a lesser degree, arsenic may tend to mobilize into shallow groundwater due to locally reducing conditions caused by degradation of organic matter in the underlying Bay Mud. In addition, once the arsenic dissolves into groundwater, arsenic concentrations remain relatively stable over time. When the petroleum source and reducing conditions abate, arsenic concentrations may tend to slowly decrease due to dilution, dispersion, and transport.

Remedial Units

Based on the occurrence of contaminants above cleanup levels three soil remedial units (RUs) and one groundwater RU were identified. These RUs are discussed below.

Soil Remedial Unit A – Soil Remedial Unit A (RU-A) is located beneath, north, south of Building 1063 and comprises approximately 1,070-100 cubic yards (cy) of soil. At RU-A, the COCs, benzo(a)pyrene, TPHd, TPHf, TPHg, 2-hexanone, benzene, ethylbenzene, toluene, lead, cadmium, and arsenic, were detected above cleanup levels in vadose-unsaturated and saturated zone soil between 2.5 and 8.5 feet below ground surface (bgs). Contamination is not expected to extend below 8 to 8.5 feet bgs, the estimated top of the Bay Mud aquitard in this area. Building 1063, constructed in 1941, is considered to be a historic structure of contributive value to the National Historic Landmark (NHL) and therefore, has been designated to be preserved. The Trust plans to reuse and rehabilitate the building to house a recycled water treatment plant. At locations in Building 1063 where heavy equipment and storage tanks will be installed, the Trust plans to remove roof support columns, remove the roof, remove a portion of the south building wall, saw cut and remove the concrete floor slab, excavate soil, and install a water storage tank that will be partially below grade. These planned demolition activities will provide access to contaminated soil that currently underlies the concrete slab floor.

Soil Remedial Unit B – Soil Remedial Unit B (RU-B) is located in an area of debris fill in the northwestern portion of the site. At RU-B, the COCs, TPHd, TPHf, benzene, benzo(a)pyrene, cadmium, lead, and zinc were detected in unsaturated and saturated zone soils between 2 and 7.3 feet bgs at concentrations exceeding cleanup levels. Contamination is not expected to extend below 8 to 9 feet bgs, the estimated depth of Bay Mud in this area. The estimated volume of impacted soil is approximately 9,200 cy. The area underlies a paved parking lot with landscaped traffic islands and in an area that lies within the freshwater ecological protection zone. The areal extent of COCs in shallow soil has not been

fully delineated at this RU. As explained in this CAP, additional sampling in the area of RU-B is planned as part of the upcoming remedial investigation of a remediation site known as Fill Site 6B.

Soil Remedial Unit C – Soil Remedial Unit C (RU-C) is located partially beneath the west wall of Building 1040, adjacent to a former fuel oil AST. At RU-C, the COCs, TPH_{fo}, and TPH_d are present above cleanup levels in saturated soil at 7.7 feet bgs. The estimated volume of impacted soil is approximately 90 cy. Building 1040 was constructed in 1920 and formerly operated as a power house/steam plant. The building is a historic structure and is of contributive value to the NHL and therefore, has been designated to be preserved.

Groundwater Remedial Unit A – Groundwater RU-A comprises shallow groundwater (6 to 12 feet bgs) beneath and adjacent to the south wall of Building 1063 containing TPHg and benzene above cleanup levels. This unit is in the same location as Soil RU-A and is believed to be associated with contaminated soil found at that location.

Recommended Corrective Actions

Potential remedial technologies were screened based on their effectiveness, implementability, and relative costs in treating the COCs identified in soil and groundwater at the site. Based on this screening, the following technologies were retained for further consideration with respect to cleanup of the identified RUs.

1. No Action.
2. Capping, Land Use Controls (LUCs), and Groundwater Monitoring (for RUs with COCs in groundwater above cleanup levels).
3. Excavation and Offsite Disposal of Soil, Application of In Situ Oxygen Release Product, and Groundwater Monitoring.

Recommended alternatives for each RU are summarized below. Remedial actions selected are those that are protective of human health, the environment, groundwater quality, are cost-effective, allow reuse of the Presidio under the Presidio Trust Management Plan (PTMP), and meet Site Cleanup Requirements (SCRs) under RWQCB Order No. R2-2003-0080.

Elevated dissolved arsenic concentrations in shallow groundwater are likely the result of geochemical changes caused by locally reducing conditions from degradation of organic matter in the underlying Bay Mud and degradation of petroleum hydrocarbons. Therefore, no formal arsenic groundwater RU has been established and groundwater monitoring for arsenic has been incorporated into the corrective action for RU-A (MACTEC, 2006).

Soil and Groundwater RU_{uss}-A—Alternative 3 (Excavation)

The recommended alternative for co-located Soil and Groundwater RU_{uss}-A is Alternative 3 (Excavation and Offsite Disposal of Soil, Application of In Situ Oxygen Release Product as Necessary, Groundwater Monitoring). Alternative 3 is recommended for implementation at co-located Soil and Groundwater RU_{uss}-A because it is technically effective and takes advantage of the opportunity to remove the majority of contaminated soil from beneath Building 1063 prior to or and in coordination with the water treatment plant project construction during renovation of planned withifom the building, is readily implementable and cost-effective. Although t~~This alternative is higher in~~ has similar estimated costs than as Alternative 2 (Capping, LUCs, Groundwater Monitoring), and removes contaminated soil ~~is removed~~ permanently from the site, thus eliminating the potential for future exposures. In addition, it is

assumed that ‘clean closure’ of these RUs could be achieved after groundwater monitoring verifies concentrations of COCs are below cleanup levels due to source removal (excavation) and via and supplemental remediation of residual contamination using in situ oxygen release product. The total estimated cost to implement Alternative 3 ~~for~~ RUs-A is ~~\$706,000~~526,900.

Soil Remedial Unit B—~~[[No Recommendation]]—Alternative 2 (Capping, Land Use Controls)~~

Because the areal extent of COCs in shallow soil at RU-B have not been fully characterized, a final corrective action for this RU cannot be selected in this CAP. RU-B will be investigated by the Trust as part of its upcoming remedial investigation related to Fill Site 6B.; Remedial actions for this RU will be evaluated as part of the remedy analysis for Fill Site 6B.

~~The recommended alternative for Soil RU-B is Alternative 2 (Capping, LUCs). Under this alternative, the existing asphalt parking area would be inspected for improvements, and pavement would be extended over limited uncovered portions of Soil RU-B to isolate the contaminated soil from human exposure. This alternative would be consistent with the current and future reuse of the parking area. Alternative 2 is recommended for implementation at Soil RU-B because it is technically effective and readily implementable and cost effective. Contamination in this RU occurs at relatively low levels over an extensive area (9,200 cy), is varied and ubiquitous within fill material in soil, does not appear to have impacted groundwater, and occurs beneath an asphalt paved parking lot that is already serving as a cap and mitigating potential exposures. In addition LUCs would restrict future land uses to those compatible with safeguarding the integrity of the cap. This alternative is much lower in cost than Alternative 3 (Excavation), under which contaminated soil is permanently removed from the site. The total estimated cost to implement Alternative 2 at RU-B is \$446,000.~~

Soil Remedial Unit C—Alternative 2 (Capping, Land Use Controls)

The recommended alternative for Soil Remedial Unit C is Alternative 2 (Capping, LUCs). Under this alternative, the northwestern portion of the Building 1040 foundation and adjacent area would be inspected for improvements. This alternative would be consistent with the current and future reuse of this historic building that will be preserved but not occupied in the future. Alternative 2 is recommended for implementation at Soil RU-C because it is technically effective and readily implementable and cost-effective. Contamination in this RU occurs at relatively low levels and is limited in extent (90 cy), does not appear to have impacted groundwater, and occurs beneath the foundation of an existing historic building area that is already serving as a cap and mitigating potential exposures. In addition LUCs would restrict future land uses to those compatible with safeguarding the integrity of the cap. This alternative has a relatively low cost. The total estimated cost to implement Alternative 2 at RU-C is ~~\$54,000~~89,000.

~~Elevated dissolved arsenic concentrations in shallow groundwater are likely the result of geochemical changes caused by locally reducing conditions from degradation of organic matter in the underlying Bay Mud and/or degradation of petroleum hydrocarbons. Therefore, no formal arsenic groundwater RU has been established and groundwater monitoring for arsenic has been incorporated into the corrective action for RU-A.~~

UST, AST, and FDS Line Closures

Based on review of soil and groundwater data from these previous corrective actions and subsequent investigations, it appears that there is no residual contamination from UST 1027, FDS lines along Girard and Edie Roads (FDS line segments BR8-1, BR16-1, and BR10-3), Water Storage Tanks 1047.1, 1047.2, and 1047.3, Building 1047 Hydraulic Storage Tank and Elevator Pit, Building 1062 Hot/Well Sump, and UST 1047.4. Accordingly, it appears that these units can be closed. Upon completion of the cleanup

described in this CAP, the Trust plans to request closure of these former USTs, ASTs, sumps, and FDS lines in the Completion Report documenting implementation of the selected corrective actions.

1.0 INTRODUCTION AND OVERVIEW

This Corrective Action Plan (CAP) has been prepared by MACTEC Engineering and Consulting, Inc. (MACTEC) on behalf of the Presidio Trust (the Trust) to evaluate and select corrective action alternatives to address soil and groundwater contamination at the Building 1065 Area, Presidio of San Francisco, California (the site). The CAP addresses contamination that is related to or co-located with releases of petroleum hydrocarbons from past use of the site. Remedial actions selected will be those that are protective of human health, the environment, groundwater quality, are cost-effective, allow reuse of the Presidio under the Presidio Trust Management Plan (PTMP), and meet Site Cleanup Requirements (SCRs) under California Regional Water Quality Control Board (RWQCB) Order No. R2-2003-0080 (RWQCB Order).

Data from previous corrective actions associated with removals of underground storage tanks (USTs), above ground storage tanks (ASTs), sumps, and fuel distribution system (FDS) lines ~~are being~~were considered when evaluating and selecting corrective action alternatives for this site. Upon completion of the cleanup described in this CAP, the Trust plans to request closure of these former USTs, ASTs, sumps, and FDS lines in the Completion Report documenting implementation of the selected corrective actions.

A CAP was previously prepared by the United States Army (Army, *IT Corporation [IT], 1999a*), but was not implemented by the Trust because the nature and extent of contamination at the site had not been adequately characterized. In addition, since the Army CAP was prepared, the Trust has developed cleanup levels for human and ecological receptors that needed to be considered when identifying remedial units (RUs) at the site. Since 1999, two additional site investigation programs, three corrective actions, and over five additional years of groundwater monitoring have been performed. These data were used to evaluate the nature and extent of contamination, identify remedial units (RUs), and select corrective action alternatives to cleanup the site.

The following sections provide a description of the site setting, a brief site history, planned land use, and regulatory framework that provides a context for the decisions made in identifying areas of contamination and selecting corrective action alternatives for the site.

1.1 Presidio Background

The site is located in the northeast portion of the Presidio of San Francisco (Presidio; Plate 1). The Presidio occupies approximately 1,416 acres at the northern end of the San Francisco peninsula. It is bounded on the north by San Francisco Bay, on the west by the Pacific Ocean, and on the south and east by residential neighborhoods of the City of San Francisco. The Presidio lies within San Francisco City and County limits.

The Presidio was established in 1776 as a military garrison under commission of the government of Spain. Mexico took control of the base in 1822, but abandoned it in 1835. In 1847, American colonists occupied the Presidio as a garrison. The Presidio operated as an Army installation from 1848 through 1994. During that time, the Presidio served as a mobilization and embarkation point during several overseas conflicts, was used as a medical debarkation center, and provided coastal defense facilities for the San Francisco Bay area. Although no heavy industrial operations have reportedly occurred at the Presidio, light industrial operations included vehicle and aircraft maintenance and repair, fuel storage and distribution, medical and laboratory facility operations, weapons operations, printing and painting, and dry cleaning. Historical activities at the Presidio generated hazardous wastes (including waste solvents, paints, batteries, and corrosive liquids) and other miscellaneous wastes (including medical wastes and waste oil products) (*TetraTech, 2001*).

In 1963, the Presidio was designated a registered National Historic Landmark (NHL), and in 1966, the installation was listed on the National Register of Historic Places. The Presidio was recommended for closure by the U.S. Secretary of Defense's Commission on Base Realignment and Closure (BRAC) in December 1988. The Presidio was transferred to the U.S. Department of the Interior, National Park Service (NPS) in 1994 and became part of the Golden Gate National Recreational Area (GGNRA) under Public Law 92-589. As required by the BRAC Act, the Army initiated environmental studies in conjunction with the transfer of the property. In 1996, the Trust was established under Section 103 of the Omnibus Parks and Public Lands Management Act of 1996, Public Law 104-33, 110 Stat. 4097 (Trust Act) as a federal government corporation with the purpose of managing the leasing, maintenance, rehabilitation, and improvement of the non-coastal portions of the Presidio in accordance with the General Management Plan Amendment (GMPA; NPS, 1994) for the Presidio. The NPS retained management responsibility for the coastal portions of the Presidio.

On May 24, 1999, the Army, the Trust, and the Department of the Interior (specifically the NPS) entered into a Memorandum of Agreement (MOA). Pursuant to this MOA, the Army delegated to the Trust its authority for remediation of contamination at the Presidio. The U.S. Army has retained responsibility for contamination that might be encountered related to unexploded ordnance; nuclear, biological, and chemical weapons or agents; offshore areas; and other unknown contamination as defined in the Presidio MOA. Because the Presidio is not listed on the National Priorities List, the lead regulatory oversight agency for the Presidio is the California Environmental Protection Agency Department (Cal/EPA) of Toxic Substances Control (DTSC).

1.2 Site Setting

The site is approximately 4.5 acres and is bounded to the north by Gorgas Avenue and to the east by Kendall Drive. Edie Road borders the site to the south but the site also includes the area around a former underground storage tank (UST) associated with Building 1027, south of Edie Road. The western boundary border is defined by the edge of a parking area and vacant lot and lies just east of Building 207/231 area and Buildings 1029, 1030, and 230 (Plate 2). The area slopes to the north-northeast with elevations ranging from approximately 13 to 26 feet above the Presidio lower-low water vertical datum (PLW; IT, 1999a).

The site was historically used for vehicle maintenance, and contained a service/gas station, garage, laundry with dry cleaning facility, crematory, paint shop, power house/steam plant, fuel oil storage, and fuel oil distribution lines, occupational therapy building, warehouses, isolation ward and prison, wagon shed, and an incinerator (Section 2.1). The site consists of historical buildings, paved parking areas, roadways, and some landscaping. When selecting corrective action alternatives for this site, protection of and reduction of potential impacts to these historically sensitive buildings located at the site will need to be considered.

Two remedial action sites, Fill Site 6A and the Building 207/231 Area, lie southwest and northwest of the site, respectively (Plate 1). Fill Site 6A comprises debris from building demolition and contains metals and polychlorinated biphenyls (PCBs) above Presidio cleanup levels. Fill Site 6A ~~is being~~has been cleaned up under the Presidio Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Cleanup Program (MACTEC, 2005a). Clean closure is the selected remedy for Fill Site 6A, and soil excavation and removal activities area ~~planned for~~were conducted in the Summer of 2005. The Building 207/231 Area, located southwest of the site, is the former location of railroad tracks, service stations, a car wash, fuel oil distribution lines, a laundry, and garage. Past site operations included use, storage, and distribution of petroleum fuels and Stoddard solvent. A CAP ~~is being~~has been developed to address petroleum hydrocarbon contamination related to past use of the Building 207/231 Area under the Presidio Petroleum Cleanup Program.

The Building 1065 Area boundary also overlaps with the footprint of a third site, Fill Site 6B. Fill Site 6B is comprised, in part, of debris fill that may include material placed prior to site development in 1920 or placed between 1963 and 1977, when a number of buildings in the area were demolished. A Remedial Action Plan (RAP) under the Presidio CERCLA Cleanup Program is being prepared for this site. Plate 1 shows the ~~current mapped configuration of~~ Fill Site 6B investigation area. The limits of Fill Site 6B will be further defined as part of the RAP. ~~This CAP will address petroleum contamination and co-located contaminants potentially related to fill materials in the portion of the site that overlaps with Fill Site 6B.~~

~~Remedial actions at these sites will be coordinated through the Trust Remediation Department to optimize use of equipment, personnel, and to reduce impacts to tenants and visitors to the Presidio.~~

1.3 Planned Land Use

The Building 1065 Area is located in the Letterman Complex Planning District within Area B of the Presidio, and therefore, is subject to land uses identified in the PTMP (*Trust, 2002*). The Letterman Complex Planning District is an urban area, which has a history of intensive land use and development. The planned use of the Building 1065 Area includes residential and institutional use in the southwestern portion of the site and commercial and recreational use for the remainder of the site (Plate 3).

Building 1063 and the area between Buildings 1063 and 1064 are planned to be used to house a recycled water treatment plant with a below grade water storage tank (Plate 2). Building 1063 has been identified as a historically sensitive building. At locations in Building 1063, where heavy equipment and storage tanks will be installed, the Trust plans to remove roof support columns, remove the roof, remove a portion of the south building wall, saw cut and remove the concrete floor slab, excavate soil, and install a water storage tank that will be partially below grade. These building demolition activities have been approved by the Trust N² group, a team of Trust Resource Specialists that review prospective projects to make sure that project activities are performed in accordance with the National Environmental Protection Act (NEPA), Section 106 of the National Historic Preservation Act (NHPA), and the Presidio Programmatic Agreement. These building demolition activities will allow access to contaminated soil beneath Building 1063. A proposed onramp for Doyle Drive is planned to be constructed in an area north of the site and Girard/Thornberg Roads are planned to be extended in the southern portions of the site. These projects will need to be considered during the implementation phase of the CAP.

West of the site is the planned location of the Tennessee Hollow riparian corridor (Plate 1). Planned restoration activities in this area include creation of a freshwater stream that will discharge into the tidal wetlands of Crissy Field. In Order No. 96-070, the RWQCB (*RWQCB, 1996*) defined a freshwater ecological protection zone (FEPZ) around the planned alignment of proposed riparian corridor. This FEPZ was maintained in the later order No. R2-2003-0080 (*RWQCB, 2003*). The FEPZ runs across the western portion of the site (Plate 4). Cleanup levels protective of ecological receptors will be applied in this portion of the site and remedial actions in this portion of the site must consider this planned land use.

The Building 1065 Area is located in the Northeastern Area of the Marina Groundwater Basin, which is a possible-potential source for municipal water supply and surface water replenishment. The groundwater is not currently used as an active drinking water source. Remedial actions selected for this site will consider actual and identified-potential beneficial uses of groundwater in the site vicinity.

1.4 Regulatory Framework

The RWQCB Order names the Army, Trust, and NPS as dischargers of pollutants to soil and groundwater and lists the Building 1065 Area as a petroleum site, requiring preparation of this CAP. The Building

1065 is a listed petroleum site because past use of the site included storage of gasoline, diesel, Stoddard solvent, and fuel oil in aboveground storage tanks (ASTs) and USTs. In addition, fuel oil distribution lines ran through the area and the area was used for vehicle maintenance activities that included use of a wash rack and sumps.

This ~~Draft~~ CAP has been prepared in accordance with Task 6 of the RWQCB Order. The ~~Draft~~ CAP also fulfills the California requirements of Title 23, California Code of Regulations (CCR), Division 3, Chapter 16, Article 11; and California Health and Safety Code, Chapter 6.8. Cleanup Levels for the site are specified in the ~~Draft~~ CAP. Petroleum contaminant cleanup levels are based on the SCRs listed in the RWQCB Order. Cleanup Levels for non-petroleum contaminants are based on the planned land use and site lithology(ies) and ~~are were~~ developed in accordance with the Development of Presidio-Wide Cleanup Levels for Soil, Sediment, Groundwater, and Surface Water (*Erler & Kalinowski, Inc. [EKI], 2002*); *Table 7-6 Revised May, 2006*) (Cleanup Level Document). Blasland, Bouck, & Lee, Inc. (BBL) developed point of compliance concentrations (POCCs) for total petroleum hydrocarbons as diesel (TPHd) and total petroleum hydrocarbons as fuel oil (TPHfo) in surface water and sediment of the FEPZ and identified the “zone of application,” which in response to the RWQCB Order Tasks 2 and 3 and addressed in the *Draft, Development of Freshwater TPH-diesel and TPH-fuel oil Point of Compliance Concentrations, Presidio of San Francisco, San Francisco, California (BBL, 2004)*. Applicable state and federal laws are identified and presented in Section 5.3.

1.5 Public Participation

This ~~Draft~~ CAP ~~will be was~~ subject to public review and comment ~~including the as following follows~~:

- Consultation and coordination of corrective action alternatives and selection decisions with the Presidio Restoration Advisory Board (RAB), NPS, and regulatory agencies.
- Preparation of response to comments received on the ~~Draft~~ CAP. The response to comments for this CAP ~~will be completed following receipt of stakeholder comments and will baree~~ included as Appendix A ~~in the Final CAP~~.

2.0 SITE BACKGROUND

This section describes the site history, identified potential source areas, and previous investigations and corrective actions that provide the basis for our current understanding of site geologic and hydrogeologic conditions and the nature and extent of contamination at the site. This section also provides a discussion of site geology and hydrogeology, contaminants present in soil and groundwater, and describes the source and distribution of contaminants in soil and groundwater at the site.

2.1 Site History

The site was historically used for vehicle maintenance, and contained a service/gas station, garage, laundry with dry cleaning facility, crematory, paint shop, power house/steam plant, fuel oil storage and distribution lines, occupational therapy, warehouses, isolation ward and prison, wagon shed, and an incinerator. The site includes the former locations of Buildings 38, 50, 60, 268, T274, 1033/1034, 1035, 1064 (old and new), 1065, 1066, 1067, 1068, 1070, 1071, present locations of Buildings 1040, 1047, 1062, and 1063, and the area just west of Building 1027. A summary of use histories for the buildings formerly or currently occupying the site are provided below.

Existing Building 1040 – Building 1040 formerly operated as a power house/steam plant that used fuel oil contained in a 20,000-gallon AST (Tank 1040.2) and a 250-gallon auxiliary AST (Tank 1040.1). These two tanks were located just outside the northwest corner of the building (Plate 2). There was also an overpressure steam vent west of the building. Tank 1040.2 was filled via a fuel distribution system (FDS) pipeline that ran north from Edie Road along the west and south sides of Building 1040. The ASTs and adjacent sections of the FDS lines were removed by IT in 1996. A description of activities associated with removal of these ASTs and pipelines is provided in Section 2.3.2.

Existing Building 1047 – Building 1047 was the former post laundry. On the west side of Building 1047 were three ASTs (Tanks 1047.1, 1047.2, and 1047.3) that contained water used by the laundry. The ASTs were removed in 1996 (Section 2.3.2). The laundry is no longer operating and the building is unoccupied. Review of a 1944 planned layout drawing from NPS archives, showed that there was a dry cleaning facility in the northeast corner of the first floor of Building 1047. The drawing showed three Stoddard Solvent tanks and one gasoline tank located in the street outside of the building. In 2003, one of these USTs (Tank 1047.4) was discovered and removed. A description of activities associated with removal of this UST and associated pipelines is provided in Section 2.3.2. Building 1047 also contained an elevator and associated hydraulic fluid storage tank. In 2002, hydraulic fluid was removed from the elevator pit and storage tank and the pit and tank were steam cleaned and the residual product and rinsate removed. A description of activities associated with cleanup of the elevator pit and hydraulic fluid storage tank is provided in Section 2.3.2.

Existing Building 1062 – Building 1062 formerly served as an occupational therapy facility and is currently unoccupied. There was a separator sump just west of Building 1062 identified as a hot well on several maps from previous investigations; its use is unknown. Two walls and the floor of the sump were removed by the Trust in 2002. The remaining two walls were removed as part of the Phase I Interim Action (Phase I IA) in 2003. A description of activities associated with removal of the sump is provided in Section 2.3.2.

Existing Building 1063 – Building 1063 is an empty warehouse. Building 1063 and the area between Buildings 1063 and 1064 are planned to be used to house a water treatment plant with a below grade water storage tank.

Former Building 1064 - Old – Old Building 1064, which was formerly located south of Building 1065, served as the Post Exchange service station. There were four USTs associated with the service station: one 375-gallon UST (Tank 1065.3), two 550-gallon USTs (Tanks 1065.1 and 1065.2), and one 250 gallon UST (Tank 1065.4). USTs 1065.1 through 1065.3 stored diesel fuel and gasoline. It is not known what was stored in UST 1065.4. USTs 1065.1 through 1065.3 were removed by IT in 1996. Tank 1065.4 was discovered and removed in 2003, during the Phase I IA. A description of activities associated with removal of these USTs is provided in Section 2.3.2.

Former Building 1064 – New – New Building 1064 was an aluminum storage shed. The building was designated Building 1064 before it was demolished by the NPS in 1996.

Former Building 1065 – Building 1065 was constructed in 1919 and was used as the Post Exchange auto shed and maintenance shop. The eastern portion of the building was used for painting office furniture. The western portion of the building housed two incinerators that were used to destroy pathological wastes. These incinerators were removed in the mid-1990s, and Building 1065 was demolished by the NPS in 1996. During the Phase I IA, a concrete sump and hoist were discovered and removed while excavating soil from beneath the foundation of this former building.

Former Building 1066 – This building was used as the Post garage beginning in 1931. In 1932, a fuel pump and 1,500-gallon UST were installed at the building. According to the Army maintenance records, the gas pump and UST were removed in 1940 and 1941. In 1941, the UST was replaced by a 6- by 12-foot UST that stored gasoline (IT, 1999b). There is no specific information concerning the locations of the pumps or USTs, nor are there records describing the removal of the second UST. A geophysical survey and trenching investigation were conducted to identify if the UST was still buried in the vicinity of Building 1066. The investigation showed that there were no USTs remaining in this area (Section 2.3.2). Site plans show a former wash rack at the eastern end of the building.

Existing Building 1027 – Building 1027 is not included in the site. However, the area around a 12,000 gallon fuel oil UST, formerly located approximately 20 feet from the northwest corner of Building 1027, is included in the site area (Plate 2). The UST was removed in 1993. A description of activities associated with removal of this UST is provided in Section 2.3.2.

Former Building 268 – This former building is shown on a 1948 vintage map. Quartermaster (QM) records indicate that Building 268 was an open-front, woodshed with dimensions of 20- by 150-feet. The former use of this building is unknown.

Former Building T274 – This former building is shown on a 1943 map. The building was constructed in 1941 and was a 1,640-square-foot, 1-story, wood frame building with a masonry-concrete floor. The building reportedly served as a storeroom and orderly room.

Former Buildings 1033/1034 (Also referred to as Buildings 55, 56, and 62) – These former buildings are shown on maps dated between 1924 and 1970. The buildings were identified as an isolation ward and prison building. The Isolation Ward (G-12) was constructed in 1912. From maps and records, it appears that an older isolation ward was present at this location and later, a newer larger isolation ward was built. An addition to the building was constructed in 1931. In 1970, the building consisted of two floors with a basement. The building was demolished between 1970 and 1975.

Former Building 1035 (Also referred to as Building 26) – This former building was shown on maps dated between 1909 and 1970. The building was a 2-story building with basement that was designated as Storehouse “A” and QM Warehouse, QM Offices, Commissary, Warehouse. Building 1035 was constructed in 1903; an addition to the building was built in 1941. According to building plans, the building was used for storage, detention, occupational therapy (including arts and crafts such as ceramics,

jewelry, leather, art, carpentry, printing, and painting), an eye clinic, and a medical office (exam rooms, testing room, laboratory, offices, storage, and classroom). In 1949, a kiln may have been installed for ceramics. The building was demolished between 1970 and 1975.

Former Building 1067 – This former building was shown on maps and aerial photographs dated between 1958 and 1961; its use is unknown.

Former Building 1068 (Also referred to as Building 38) – This former building was shown on maps or aerial photographs dated between 1920 and 1966. The building was constructed in 1909 and was identified as the M.A. Paint Shop on a building information sheet. Steel tanks and dipping tanks for paint were installed at the building in 1928 or 1929. Building plans dated 1948 indicate the following proposed arts and crafts additions: leather, weaving, printing, carpentry, plastics, and ceramics.

Former Building 1069 (Also referred to as Building T270) – This former building was shown on maps dated between 1948 and 1966. Its use is unknown.

Former Building 1070 (Also referred to as Building 40) – This former building served as the nurse's garage and was shown on maps dated between 1924 and 1961. Review of the historical maps suggests that the older garage was replaced by a newer garage.

Former Building 1071 (Also referred to as Building 20) – This former building was identified on maps dated between 1924 and 1966 as a nurses' garage and storage.

Former Building 50 – This building was identified as a crematory on a 1915 vintage map. No further information is available concerning this building.

Former Building 38 – This former building was identified as a wagon shed on a 1915 map. No further information is available concerning this building.

Former Building 60 – This former building was identified as a garage for ambulances on a 1915 vintage map. No further information is available concerning this building.

2.2 Potential Source Areas

Based on our current understanding of past use of the site, the following potential source areas were identified. These potential source areas are identified on Plate 2.

- ***Fuel Distribution System*** – Former locations of the FDS pipelines, which ran northwest-southeast along Edie Road ([FDS line segments BR8-1 and BR16-1](#)), continuing along Girard Road ([FDS line segment BR16-1](#)) and along Birmingham Road ([un-named FDS line segment](#)), are shown on Plate 2. A branch of the pipeline ran north along the west side of Building 1040 to the former ASTs and into Building 1040. Contaminants associated with the fuel oil distribution system line include extractable petroleum hydrocarbons and polynuclear aromatic hydrocarbons (PAHs) associated with heavy-end petroleum hydrocarbons.
- ***Former ASTs at Building 1040*** – ASTs 1040.1 and 1040.2, which stored fuel oil, were located northwest of Building 1040. Contaminants associated with these ASTs included extractable petroleum hydrocarbons and PAHs associated with heavy-end petroleum hydrocarbons.
- ***Former USTs at Building 1065*** – USTs 1065.1, 1065.2, 1065.3, and 1065.4, which stored gasoline and diesel fuel, were located in a common excavation south of former Building 1065. Contaminants associated with these USTs include volatile and extractable petroleum

hydrocarbons, and PAHs associated with heavy-end petroleum hydrocarbons, benzene, toluene, ethylbenzene, and xylenes (BTEX), and lead.

- **Former Stoddard Tank at Building 1047** – UST 1047.4, which stored Stoddard Solvent, was located in Kendall Avenue just west of Building 1047. Contaminants associated with this UST include petroleum hydrocarbons in the Stoddard Solvent range.
- **Former UST at Building 1027** – This UST, which stored fuel oil, was located approximately 20 feet from the northwest corner of Building 1027, near the intersection of Girard and Edie roads. Contaminants associated with this UST are extractable hydrocarbons and PAHs associated with heavy-end petroleum hydrocarbons.
- **Incinerator, Maintenance, and Painting Shop at Building 1065** – Contaminants associated with past use of this building include chemicals associated with use of the incinerator, as well as gasoline, diesel, motor oil, solvents, and paints associated with use of the maintenance and paint shop. The specific chemical compound classes include dioxins and furans, PAHs, volatile and extractable petroleum hydrocarbons, BTEX, volatile organic compounds (VOCs), and metals.
- **Sump/Hot Well at Building 1062** – The sump/hot well was located west of Building 1062. Contaminants potentially associated with the sump/ hot well are volatile and extractable petroleum hydrocarbons, BTEX, VOCs, and metals.
- **Wash Rack at Former Building 1066** – The former wash rack was at the eastern end of the former Building 1066. Contaminants associated with the wash rack include chemicals associated with parts cleaning and equipment maintenance (e.g., solvents, spent motor oil, gasoline, and diesel fuel). These contaminants include volatile and extractable petroleum hydrocarbons, BTEX, VOCs, cadmium, chromium, lead, nickel, and zinc.
- **Laundry Facility at Building 1047** – Activities at this building included possible use of dry-cleaning solvents and pesticides (possibly used for de-lousing).
- **Crematory** – A 1915 site plan showed a crematory in the western portion of the site. Contaminants potentially associated with the crematory included PAHs, metals, and dioxins and furans.
- **Building 1068 – MA Paint Shop** – This building was located in the western portion of the site and contained steel tanks and dipping tanks for paint. Contaminants potentially associated with this paint shop include metals.
- **Contaminated Fill** – Fill from building demolition is present in the western portion of the site. Contaminants associated with the fill may include metals, and PAHs, and possibly asbestos.

2.3 Previous Site Investigations and Past Corrective Actions

Previous investigations and corrective actions were conducted by the Army and the Trust to assess the nature and extent of contamination at the Building 1065 Area, close existing USTs, ASTs, sumps, and FDS lines, perform interim actions, and evaluate corrective action alternatives. The Trust is currently conducting a base-wide groundwater monitoring program that includes sampling of piezometers and monitoring wells. These investigations, monitoring programs, and corrective actions are summarized below.

2.3.1 Previous Site Investigations

Previous investigations conducted by the Army consisted of a Preliminary Assessment, Site Investigation, Remedial Investigation (RI), and a previous CAP. The Trust conducted two additional site characterization investigations to address data gaps identified from review of results of previous investigations and has been conducting a quarterly groundwater monitoring program at the site. The following provides a brief description of the scope of each of these investigations and monitoring programs. Analytical results from soil and groundwater samples from these investigations are posted on Plates 6 through 11 (with the exception of areas where soil has been removed and the analytical data ~~is~~ are no longer relevant). As appropriate, data from these investigations have been incorporated into our interpretation of site geologic and hydrogeologic conditions and the nature and extent of contaminants in soil and groundwater.

Remedial Investigation – A remedial investigation was conducted by Dames and Moore (D&M) in 1994 that included collection of soil and groundwater samples from nine borings (1065SB01 through 1065SB09; Plate 2) in the vicinity of Building 1065 (*D&M, 1997*). Soil samples collected from 0.5, 5, and 10 feet bgs from four of the borings were screened for total petroleum hydrocarbon (TPH) using immunoassay methods; the samples were then analyzed for TPHd and total petroleum hydrocarbons as gasoline (TPHg). Soil samples were screened for lead using an x-ray fluorescence (XRF) detector and selected samples were analyzed for lead. Groundwater samples were collected at:

- Discrete depth intervals (7 to 15, 18 to 22, 28 to 30, and 40 feet below ground surface [bgs]) from seven borings;
- 5 feet bgs from Boring 1065SB01; and
- 7 and 10.5 feet bgs from Boring 1065SB02.

The groundwater samples were analyzed for TPHd, TPHg, and lead. Samples analyzed for lead were not filtered, and concentrations, therefore, represented both dissolved and suspended lead.

Preliminary Site Assessment – A passive soil gas survey, using a Gore-Sorber method, was conducted in 1996 as part of a preliminary site assessment at the Building 1065 Area (*IT, 1996*). Samples were analyzed for VOCs, including BTEX, PAHs, and other petroleum constituents. Passive soil gas sampling locations and results are presented in Appendix D of the Work Plan (*Harding ESE, 2002a*).

Site Investigation – IT conducted a site investigation in 1997 (*IT, 1997a*) that included drilling and sampling 21 soil borings (1065SB10 through 1065SB30), seven piezometer pairs (one in the shallow groundwater zone and one in the intermediate zone; 1065PZ1A/B through 1065PZ7A/B), one boring that was not piezometer (1065PZ0A), and 32 HydroPunch borings (1065HP01 through 1065HP030, 1065HP34, and 1065HP35) (Plate 2).

Soil samples were collected from the soil borings and A-piezometers at 3 to 3.5 feet bgs and just above the capillary fringe (4.5 to 10.5 feet bgs). Groundwater samples were collected from HydroPunch borings at depths of 6 to 12 feet bgs (shallow groundwater) and 17 to 26 feet bgs (intermediate groundwater). Deeper samples (27.5 and 29 feet bgs) were also collected from HydroPunch Borings 1065HP04 and 1065HP06. Soil and groundwater samples were analyzed for TPHg, corresponding to hydrocarbons in the carbon (C) range of C7 to C12; TPHd, corresponding to hydrocarbons in the C12 to C24 range; TPH quantified as total petroleum hydrocarbons as motor oil (TPHmo) or TPHfo, corresponding to hydrocarbons in the C24 to C36 range; and selected VOCs (1,1,2,2-tetrachloroethane; 1,2-dichlorobenzene [1,2-DCB]; 1,2-dichloroethane [1,2-DCA]; cis-1,2-dichloroethene [cis-1,2-DCE]; 1,3-dichlorobenzene [1,3-DCB]; 1,4-dichlorobenzene [1,4-DCB]; BTEX; chloromethane; methyl-tert

butyl ether [MtBE]; tetrachloroethene [PCE]; trichloroethene [TCE]; and vinyl chloride). Capillary fringe soil samples from 12 of the soil and piezometer borings were also analyzed for PAHs and lead. Groundwater samples from the piezometers and three HydroPunch borings were also analyzed for lead and PAHs. Groundwater samples analyzed for lead were filtered. Selected soil samples were analyzed for total organic carbon (TOC), bulk density, moisture content, corrosivity (pH), total Kjeldahl nitrogen, ammonia, orthophosphate, and bacterial enumeration. Selected groundwater samples were analyzed for anions, alkalinity, dissolved gases, and ferrous iron.

Evaluation of Fate and Transport of Oxygen from Oxygen Releasing Compounds – In 1997, IT Corporation performed a field study at the Building 1065 Area to evaluate the fate and transport of oxygen added to the subsurface using Oxygen Releasing Compounds® (ORC®) material (IT, 1999a). ORC® material was directly injected into the shallow groundwater zone. Dissolved oxygen (DO) concentrations were measured in four temporary wells that were installed 1.5 to 5 feet downgradient of the ORC® injection point. Results of the study were used to estimate a petroleum hydrocarbon biodegradation rate and estimate the size of the DO plume. One of these wells (1065TMW3) has been sampled as part of the quarterly groundwater monitoring program. This monitoring well is shown on Plate 2.

Geophysical Survey at Building 1066 – Previous investigation reports indicated that a 1,500-gallon UST and fuel pump were installed at Building 1066 in 1932. There are also records indicating that the UST and pump were removed in 1940 and 1941 and replaced in 1941 by a second 6– by 12–foot UST that reportedly stored gasoline. The locations of these former USTs and pumps are unknown and there are no records indicating that the UST installed in 1941 had been removed from the site. To identify if USTs were still buried in the vicinity of Building 1066, a geophysical investigation was performed within an approximately 100– by 200-foot parking lot area west of former Building 1065.

The investigation consisted of separate surveys using EM, magnetics (MAG), and ground penetrating radar (GPR). The survey was performed on September 28 and 29, 2001. The initial investigation identified six anomalous areas where buried metal was suspected. The areas are designated Anomaly 1 through Anomaly 6, and are shown on Plate 2. Results of the survey were described in *Harding ESE, 2002a* and *2002b*.

2001 Trenching – In November 2001, trenching was performed as part of the Doyle Drive realignment project. Because hydrocarbon odors were noted in the trench, a soil sample was collected at a depth of 5 feet bgs from trench location 1065EX50. The sample (1065EX50; Plate 2) was analyzed for TPHg, TPHd, TPHmo, MtBE, and BTEX (MACTEC, 2003a).

Additional Site Characterization – Between August 12 and November 5, 2002, MACTEC performed additional investigation activities to address data gaps that were identified from review of chemical and hydrogeologic data collected during previous investigations. Activities included a walk through of Buildings 1040 and 1047 to identify potential source areas, geophysical survey and trenching to locate an UST associated with former building-Building 1066, soil borings, installation of monitoring wells and a piezometer, well abandonment of temporary wells, and groundwater sampling (MACTEC, 2003a). Twelve anomalies were discovered during the geophysical survey. Trenches were excavated in the vicinity of former Building 1066 to investigate the geophysical anomalies. An UST was not found in the areas of the large anomalies, but a utility vault, wood debris, concrete slabs large and small, bricks, and metal debris were typically found in the trenches.

Thirteen vadose zone soil borings were drilled to 10 feet bgs, nine borings were drilled into the upper intermediate groundwater zone, and three borings were drilled into the lower intermediate groundwater zone to evaluate soil lithologic and chemical conditions. Two soil samples were collected for analysis

from each boring: one just below the surface (1 to 3 feet bgs) to evaluate if there had been a surface or shallow soil release, and one just above the groundwater table (capillary fringe; 5 to 10 feet bgs) to assess the presence of contamination that may have migrated vertically and laterally from a source area. Two groundwater samples were collected from each boring that were drilled into the upper intermediate groundwater zone: one from the shallow groundwater zone (5 to 15 feet bgs), and the second from the upper intermediate groundwater zone (15 to 25 feet bgs). Three groundwater samples were collected from each boring that were drilled into the lower intermediate groundwater zone: one from the shallow groundwater zone (5 to 15 feet bgs), one from the upper intermediate groundwater zone (15 to 25 feet bgs), and one from the lower intermediate groundwater zone (25 to 40 feet bgs).

Three monitoring well pairs were installed in the shallow and upper intermediate groundwater zones, and two soil samples were collected for analysis from each shallow well boring; one just below the surface (1 to 3 feet bgs), and one just above the groundwater table (5 to 10 feet bgs). Piezometer 1065PZ5A, which had been damaged, was abandoned and replaced. In October 2002, the new groundwater monitoring wells and piezometer were developed and sampled. Four temporary 10-foot wells that were installed as part of an ORC[®] pilot study in 1997 were abandoned.

The sampling and analytical program in each of the identified source areas is summarized below.

Fuel Distribution System (FDS) and ASTs at Building 1040

- **Soil Borings 1065SB100, -101, -102, -103, -104, -124, -125, -136, and -137** - Two soil samples were collected from each boring, one from 1 to 3 feet bgs, and one from 5 to 10 feet bgs. Two groundwater samples were collected from the shallow and intermediate zone from 1065SB103, -104, and -125. Three groundwater samples were collected from 1065SB124. Samples were analyzed for TPHd, TPHfo, and VOCs. Groundwater samples from 1065SB103 and -104 were also analyzed for lead. Soil and groundwater samples from 1065SB124 and -125 were also analyzed for lead.
- **Soil Boring 1065SB117** - Two soil samples were collected from this boring, one from 1 to 3 feet bgs, and one from 5 to 10 feet bgs. Groundwater samples were also collected from the shallow and intermediate groundwater zones. Soil and groundwater samples were analyzed for TPHd, TPHfo, VOCs, and lead.

Former USTs (Former Building 1064)

- **1065SB105** - Two soil samples were collected from this boring, one from 1 to 3 feet bgs, and one from 5 to 10 feet bgs. Samples were analyzed for TPHg, TPHd, TPHfo, BTEX, and lead.
- **1065SB110** - Two soil samples were collected from this boring, one from 1 to 3 feet bgs, and one from 5 to 10 feet bgs. Two groundwater samples were collected from the shallow and intermediate groundwater zones. Samples were analyzed for TPHg, TPHd, TPHfo, VOCs, and lead.
- **1065MW9A/B** - Two soil samples were collected from 1065MW9A, one from 1 to 3 feet bgs, and one from 5 to 10 feet bgs and two rounds of groundwater samples were collected. Samples were analyzed for TPHg, TPHd, TPHfo, VOCs, and lead.
- **1065SB123** - Two soil and three groundwater samples were collected from this boring. Samples were analyzed for TPHg, TPHd, TPHfo, VOCs, and Title 22 metals.

Maintenance and Painting Shop at Building 1065

- **1065SB107, -108, and -119** - Two soil samples were collected from each soil boring, one from 1 to 3 feet bgs, and one from 5 to 10 feet bgs. Samples were analyzed for TPHg, TPHd, TPHfo, VOCs, and Title 22 metals, PAHs. The shallow soil samples from each boring were also analyzed for dioxin and furans.
- **1065SB134 and 135** - Three soil samples were collected from each boring and groundwater samples were collected from the shallow and intermediate groundwater zone from 1065SB135. Samples were analyzed for TPHg, TPHd, TPHfo, BTEX, and Title 22 metals.

Laundry Facility at Building 1047

- **1065SB109** - Two soil samples were collected from this soil boring, one from 1 to 3 feet bgs, and one from 5 to 10 feet bgs. Samples were analyzed for TPHd, TPHfo, VOCs, pesticides, and lead.
- **1065SB118** - Two soil samples were collected at this soil boring, one from 1 to 3 feet bgs, and one from 5 to 10 feet bgs. Two Groundwater-groundwater samples were also collected from the shallow and intermediate groundwater zone. Soil and groundwater samples were analyzed for TPHd, TPHfo and VOCs. The groundwater samples were also analyzed for lead.
- **1065MW10A/B and 1065MW11A/B** - Two soil samples were collected from borings for 1065MW10A and -11A. Two rounds of groundwater samples were also collected from each well. Soil and groundwater samples were analyzed for TPHd, TPHfo, VOCs, and lead.
- **1065SB106** - One groundwater sample was collected from this boring at 45.5 feet bgs. The sample was analyzed for TPHg, TPHd, TPHfo, VOCs, and lead.

Wash Rack, Former Building 1066, and Former Paint Shop

- **1065TP127 through 129** - Two soil samples were collected from each Test-test Pit-pit and analyzed for TPHg, TPHd, TPHfo, BTEX, and lead.
- **1065SB111 through 114** - Two soil samples were collected from each soil boring, one from 1 to 3 feet bgs, and one from 5 to 10 feet bgs. Samples were analyzed for TPHd, TPHfo, VOCs, and lead. The sample from 1065SB111 was also analyzed for TPHg and the sample from 1065SB114 was also analyzed for Title 22 metals.
- **1065SB120 and -121** - Two soil samples were collected from the soil boring, one from 1 to 3 feet bgs, and one from 5 to 10 feet bgs. Two groundwater samples were also collected from the shallow and intermediate zone. Soil and groundwater samples were analyzed for TPHg, TPHd, TPHfo, and lead. Soil samples from 1065SB120 were analyzed for BTEX and samples from 1065SB121 were analyzed for VOCs, cadmium, chromium, nickel, and zinc.
- **1065SB126** - Two soil samples were collected from the soil boring, one from 1 to 3 feet bgs, and one from 5 to 10 feet bgs. Samples were analyzed for TPHg, TPHd, TPHfo, BTEX, and lead.

Building 1063

- **1065SB115** - Two soil samples were collected from this soil boring, one from 1 to 3 feet bgs, and one from 5 to 10 feet bgs. Samples were analyzed for TPHd, TPHfo, and PAHs.

Former Crematory

- **1065SB132** - Two soil samples were collected, one from 1 to 3 feet bgs, and one from 5 to 10 feet bgs. Samples were analyzed for TPHd, TPHfo, PAHs, and Title 22 metals. If evidence of ash was observed in the boring, samples were to be analyzed for dioxins and furans. Because no evidence of burned material was observed during drilling, the samples were not analyzed for dioxins and furans.

Investigation at Building 1063 and Building 1062 Hot Well/Sump – In August 2003, soil and groundwater sampling was performed beneath and downgradient of Building 1063 to evaluate the presence and extent of contaminants in soil and groundwater and to assess the presence of contaminants in groundwater downgradient of the former hot well/sump at Building 1062. A total of ten soil samples, two from each boring, were collected from soil borings 1065SB139 through 1065SB143, which were drilled beneath and downgradient of Building 1063. Soil cores were retrieved from Boring 1065SB144, downgradient of the hot well/sump for lithologic logging only. Groundwater samples were collected at two depths (shallow and intermediate groundwater zones) from the borings 1065SB139 through 1065SB144. All samples were analyzed for TPHg, TPHd, TPHfo, VOCs, and Title 22 metals (MACTEC, 2004a).

Groundwater Monitoring – Groundwater at the Building 1065 Area has been monitored since 1997 (Treadwell and Rollo [T&R], 2004). Samples are collected from 14 piezometers and seven monitoring well and analyzed for TPHg, TPHd, TPHmo, TPHfo, BTEX, MTBE, selected dissolved metals, and general water quality parameters. Groundwater sampling ~~is~~ has been performed in all wells annually and selected wells quarterly by T&R. These piezometers (1065PZ1A/B, -2A/B, -3A/B, 4A/B, 5AR/B, 6A/B, and 7A/B) and wells (1065MW9A/B, 10A/B, 11A/B, and 1047MW101) are shown on Plate 2. A summary of groundwater monitoring results is presented in Appendix B.

2.3.2 Past Corrective Actions

The following describes previous corrective actions, including removal of ASTs, USTs, FDS lines, and a Phase I IA performed to reduce exposure to construction workers by excavating contaminated soil prior to construction of the Trust's water recycling project at the site. It should be noted that these past corrective actions particularly, the excavations for ASTs 1040.1 and 1040.2 and the Phase I IA, resulted in removing significant quantities of petroleum-contaminated soil from the site and a potential source of contaminants to groundwater. The locations of these past corrective actions are shown on Plate 2.

Removal of Building 1027 UST – In 1993, Environmental Chemical Corporation (ECC) removed a 12,000-gallon UST located approximately 20 feet from the northwest corner of Building 1027 (ECC, 1993). The UST was reportedly used to store fuel oil. Following removal of the UST, soil underneath the tank was excavated to the water table (approximately 10 feet bgs). Three confirmation soil samples (NORTHEAST, CENTEREAST, SOUTHEAST; Plate 2) were collected from the excavation and analyzed for extractable hydrocarbons, BTEX, and metals. The Building 1027/Tank 1027 Mini-CAP (Montgomery Watson [MW], 1997b) reported that a groundwater sample was collected from the excavation. However there was no record of this sample being collected in the Tank Closure Report (ECC, 1993), accordingly, these results are not included in tables or shown on plates for the site. During an additional UST investigation conducted by Montgomery Watson, nine soil borings were drilled and

seven soil samples were collected from three of the borings (1027SB05, 1027SB06, and 1027SB07; Plate 2; *MW, 1996a*). Samples were analyzed for BTEX, TPH, and metals; one sample was analyzed for semi-volatile organic compounds (SVOCs). Eight HydroPunch groundwater samples were also collected and analyzed for TPHd, TPHg, oil and grease, BTEX, VOCs, and total and dissolved metals. Two monitoring wells (1027MW01 and 1027MW03; Plate 2) were installed and were monitored from July 1995 through April 1996 for TPHd, TPHg, and BTEX (*MW, 1996b*). Tables D1 and D2 (Appendix D) present detected analytical results for soil and groundwater samples collected from this area.

Two confirmation soil samples collected from the excavation (CENTEREAST and NORTHEAST) contained low concentrations (1.6 and 1.4 milligrams per kilogram (mg/kg)) of unknown hydrocarbons. TPHd and BTEX were not detected in soil. Low levels of metals were detected in all three samples (CENTEREAST, NORTHEAST, and SOUTHEAST).

TPHd was detected at 250 micrograms per liter ($\mu\text{g/L}$) in a groundwater sample collected from the excavation. Because there was no record of this sample being collected in the Tank Closure Report (*ECC, 1993*), these results are not included in tables or shown on plates for the site. HydroPunch samples identified TPHd in shallow groundwater at a maximum concentration of 180 $\mu\text{g/L}$ (1027HP02). Downgradient of the UST, TPHd was detected at a maximum concentration of 150 $\mu\text{g/L}$ (1027HPA). These samples did not undergo silica gel cleanup prior to analysis. Chloroform was detected in one HydroPunch sample collected from 1027HPA at 1.3 $\mu\text{g/L}$; no other VOCs were detected. Chromium, copper, manganese, nickel, and vanadium were also detected in one sample from 1027HP02 at the following dissolved concentrations: 4.7, 4.4, 92, 9.2, and 13 $\mu\text{g/L}$, respectively. The following metals were detected in the unfiltered sample at the indicated concentrations: arsenic at 0.015 milligrams per liter (mg/L), chromium at 0.5 mg/L, copper at 0.084 mg/L, lead at 0.053 mg/L, iron at 122 mg/L, manganese at 1.6 mg/L, nickel at 0.47 mg/L, vanadium at 0.37 mg/L, zinc at 0.28 mg/L, and mercury at 0.00025 mg/L.

In HydroPunch samples collected from the intermediate groundwater zone, TPHd was detected downgradient of the former UST at a maximum concentration of 140 $\mu\text{g/L}$ (1027HPA). Low levels of dissolved copper (0.0022 to 0.0034 mg/L), manganese (0.021 to 0.024 mg/L), and nickel (0.012 to 0.015 mg/L) were also detected in the primary and duplicate HydroPunch samples collected from 1027HP2. Metals were detected in the unfiltered samples at the following concentrations - arsenic at 0.0071 to 0.0082 mg/L, chromium at 0.24 to 0.28 mg/L, copper at 0.06 to 0.06 mg/L, lead at 0.021 to 0.024 mg/L, iron at 69.5 to 79.7 mg/L, manganese at 0.75 to 0.87 mg/L, nickel at 0.26 mg/L, vanadium at 0.16 to 0.17 mg/L, and zinc at 0.14 to 0.22 mg/L. Groundwater sampling data from 1995 indicated that TPHd was detected at 880 $\mu\text{g/L}$ in a sample collected from 1027MW03 located upgradient from the location of the former UST; however, in a split sample that underwent silica gel cleanup, TPHd was not detected. Petroleum hydrocarbons were not detected in samples collected from 1027MW01 and 1027MW03 during groundwater monitoring events conducted between July 1995 and April 1996 (Appendix B); these wells are screened across both shallow and intermediate groundwater zones.

Review of data collected in the vicinity of the former UST indicates that cleanup levels were not exceeded for soil samples collected from this area. Accordingly, it appears there is no significant impact to soil from the former fuel oil UST. Based on groundwater sampling results from previous investigations and groundwater monitoring programs, which show contaminant concentrations below cleanup levels, it appears past use of the fuel oil UST at Building 1027 has not impacted the local groundwater quality. Accordingly, it appears that UST 1027 can be closed. Therefore, after completion of the cleanup described in this CAP, the Trust shall request closure of UST 1027.

Fuel Distribution System Investigation and Removal (Edie and Girard Roads) – In 1995, Montgomery Watson performed a Phase I investigation of the FDS (MW, 1995a). The objectives of the study were to locate the FDS pipeline and evaluate whether there had been releases from the FDS. Electromagnetic (EM) field transmitting and receiving techniques were used to identify the location and depth of the FDS lines. Soil samples were collected from the bedding material beneath piping and analyzed for TPHd, BTEX, and metals.

In 1996, approximately 600 feet of lateral FDS piping ([FDS segment line Number BR8-1](#)) were removed from the Building 1065 Area (IT, 1999b). Soil around the pipeline was excavated to widths of approximately 2 to 4 feet and depths of 2.5 to 3 feet bgs. Soil samples from the trench were collected at a frequency of 1 sample per 100 lineal feet of trench and analyzed for total petroleum hydrocarbons (TPH) by immunoassay test methods. Additional excavation was performed in two areas of the trench. Approximately 31 cubic yards (cy) of soil was removed from beneath Edie Road southwest of Building 1040. At the intersection of Girard and Edie Roads, approximately 5 cy of soil was removed from the area surrounding the FDS pipeline [segment BR8-1](#). Confirmation soil samples were collected from the floor and sidewalls of the excavations and analyzed for TPH using immunoassay. One sample (FB0801L02) was submitted to an offsite laboratory and analyzed for TPHd, TPHfo, and PAHs. FDS sample locations FB0800T02, -T03, FB0801L01, -L02, -T03, -W01, -W02, -W03, FB16001T01, -T02, FDSB0800T01, -W01, FDSB0802L01, -L02, -T01, and T02 are shown on Plate 2.

In 2002, two borings, 1065SB124 and 1065SB125, were drilled along Edie Road, southwest and south of Building 1047, respectively to: (1) evaluate if there was residual TPHd, TPHfo contamination in this area from the former fuel distribution lines, (2) investigate the potential of VOCs from potential source areas, (3) assess if groundwater had been impacted, and (4) further characterize site hydrogeology.

Groundwater samples are also collected from Piezometers 1065PZ3A and -3B, downgradient of these lines. Samples are analyzed annually for metals, total dissolved solids (TDS), DO, BTEX, MtBE, TPHg, TPHd, TPHfo. Tables D3 and D4 (Appendix D) present detected analytical results for samples collected in the vicinity of the FDS lines.

Soil samples collected from 1065SB124 and 1065SB125, and 1065PZ3A contained lead at 2.0, 2.9, and 1.7 milligrams per kilogram (mg/kg), respectively. The samples collected from 1065SB124 at 3 feet bgs had a detection of TPHfo at 17 mg/kg. TPHfo was also detected at 9 feet bgs in 1065SB125 at 11 mg/kg, as well as TPH unknown diesel hydrocarbon at 5.7 mg/kg. Groundwater samples collected from 1065PZ3A and 1065PZ3B show that chromium was detected in both piezometers at 23 and 33 µg/L, respectively during 2004. Copper was also detected in 1065PZ3A at 1.3 µg/L during 2004. TPHd was detected in 1065PZ3A at 59 µg/L in 1999, and in 1065PZ3B 67 µg/L in 199 and at 110 µg/L in 2001.

Based on the review of sampling results for soil and groundwater, which show contaminant concentrations in soil and groundwater below cleanup levels, it appears the former FDS lines that ran along Edie Road and the former laundry facility at Building 1047 ([FDS line segments BR8-1, BR10-3, and BR16-1](#)) have not been significantly affected soil and groundwater quality. Accordingly, it appears that the FDS lines ([FDS line segments BR8-1, BR10-3, and BR16-1](#)) in this area can be closed.

[Therefore, after completion of the cleanup described in this CAP, the Trust shall request closure of FDS segments BR8-1, BR10-3, and BR16-1.](#)

Removal of Water Storage Tanks 1047.1, 1047.2, and 1047.3 – In 1996, one 10,900-gallon steel AST (Tank 1047.1) and two 2,500-gallon steel ASTs (Tanks 1047.2 and 1047.3) were removed from the alley between Building 1040 and Building 1047. The ASTs were water storage tanks associated with the former Post Laundry (IT, 1996). Because the tanks stored water, no confirmation samples were collected following their removal and no tank closure report was prepared. Additional sampling was performed in this area in 2002 (MACTEC, 2003a), to assess the presence and concentrations of potential contaminants

including dry-cleaning solvents and pesticides (possibly used for de-lousing). The additional sampling in this area included one 10-foot boring, 1065SB109, and Monitoring Well 1065MW11A. Samples were collected from 3 feet and 6.5 feet bgs from Boring 1065SB109 and samples collected at 3.5 and 8 feet bgs from 1065MW11A were analyzed for VOCs, TPHg, TPHd, TPHfo, pesticides, and lead.

Two adjacent monitoring wells (1065MW11A/B) were installed and sampled adjacent to Former AST 1047.1 to evaluate the presence of potential contaminants associated with Buildings 1040 and 1047. Shallow groundwater zone well 1065MW11A was screened between 8 and 15 feet bgs, and upper intermediate groundwater zone well 1065MW11B was screened between 23 and 30 feet bgs. The wells ~~are~~ have been monitored annually for metals, TDS, DO, BTEX, MtBE, TPHg, TPHd, TPHfo.

Tables D5 (Appendix D) and Appendix B present detected analytical results for soil and groundwater samples collected from this area. Soil samples show that lead was detected in the 3.5 and 8 feet bgs samples at 9.6 and 1.6 mg/kg from 1065MW11A, respectively. Lead was also detected in 1065SB109 at 280 mg/kg at 3 feet bgs and 3.1 mg/kg at 6.5 feet bgs. TPHfo, TPH unknown diesel hydrocarbon, and 2-butanone were also detected in the 3 feet bgs sample at 350, 94, and 0.013 mg/kg, respectively. TPHg, pesticides, and other VOCs were not detected. Groundwater samples collected from 1065MW11A and 1065MW11B show that chromium was detected at 12 and 40 µg/L, respectively, during 2004. MtBE was detected in 1065MW11A during August and December 2003 at 3.7 and 19 µg/L. MtBE was also detected in 1065MW11B during December 2003 at 3.1 µg/L. During 2002, TPHd was detected in 1065MW11B at 96 µg/L.

The detection of TPHfo at 350 mg/kg was the only instance of a screening level exceedance for this area. TPH was not detected in the 6-foot sample collected from this boring. In this area, depth to groundwater is greater than 5 feet below detected TPHfo in soil. Therefore, for TPH, less stringent levels apply for groundwater (depth to groundwater in Well 1065MW11A has ranged from 9.24 to 12.3 feet below casing). In this case, the most conservative applicable cleanup level for TPHfo is the human health residential cleanup level of 1900 mg/kg, which was not exceeded.

Based on the results of chemical analysis of soil samples collected from borings 1065SB109 and 1065MW11A, and Monitoring Wells 1065MW11A and -11B between and south of Buildings 1040 and 1047 (Plates 6 through 8), it does not appear that there is contamination in that area from pesticides or chlorinated solvents potentially used at the former laundry facility at Building 1047. Accordingly, it appears that Water Storage Tanks 1047.1, 1047.2, and 1047.3 can be closed. Therefore, after completion of the cleanup described in this CAP, the Trust shall request closure of Tanks 1047.1, 1047.2, and 1047.3.

Removal of ASTs 1040.1 & 1040.2 and Associated Distribution Lines – In September 1996, the 20,000-gallon and 250-gallon ASTs adjacent to Building 1040 were removed by IT (IT, 1997b). Following removal of the two ASTs and their associated piping, over-excavation was performed to remove visibly stained soil. Seventeen confirmation soil samples were collected from the footprint of the excavation (1040EX01 through -06, 1040EX08 through -011, 1040EX15 through -19, 1040EX21 and -22; Plate 2). One groundwater sample was also collected from the bottom of the excavation (sample 1040GW01). Because the precise groundwater sample location is not known, it is not shown on plates. Five of the 17 soil samples were tested for TPH using immunoassay analysis. Sixteen of the soil samples were analyzed for total PAHs using immunoassay analysis. At an offsite laboratory, 15 of the samples were analyzed for TPHd and TPHfo and two of the samples were analyzed for PAHs. The groundwater sample was analyzed for TPHd and TPHfo.

The ASTs at Building 1040 were removed and visibly contaminated soil was excavated to the extent possible. Extractable petroleum hydrocarbons were detected by immunoassay screening and in samples analyzed for TPHd and TPHfo in FDS soil samples collected in the area of the former ASTs

(FDS1040L01 through -05). Tables D6 and D7 (Appendix D) present detected analytical results for soil and groundwater samples collected from this area.

Following FDS-removal of FDS line segment Number BR8-1 and excavation of contaminated soil, concentrations in soil ranged from 1.4 to 140 mg/kg for TPHd and from 2.0 to 410 mg/kg for TPHfo. TPHfo and TPHd were detected in above cleanup levels in the following soil samples:

- 1040EX11 with TPHfo at 410 mg/kg and TPHd at 140 mg/kg; and
- FDS1040L03 with immunoassay showing TPH extractable greater than 700 mg/kg.

PAHs were detected at low concentrations in soil samples collected near or beneath the FDS lines. Detected PAHs included anthracene at 0.028 mg/kg, chrysene at 0.0497 mg/kg, fluoranthene at 0.121 mg/kg, phenanthrene at 0.0793 mg/kg, and pyrene at 0.096 mg/kg in 1040EX03. TPHd, TPHfo, and VOCs concentrations were below applicable cleanup levels in the excavation grab groundwater sample 1040GW01.

TPH concentrations at FDS1040L03 and 1040EX11 exceeded cleanup levels. Soil in these areas were potholed and contaminated soil removed as part of the Phase I IA (discussed below). Confirmation soil samples 1065EX240 (3.0) and 1065EX242 (5.0) were collected from the pothole excavations at FDS1040L03 and 1040EX11, and analyzed for TPHg, TPHd, TPHfo, VOCs. Analytical results showed:

- 1065EX240(3.0) - TPHg was detected at 0.026 mg/kg, TPHd was not detected, TPHfo was detected at 57 mg/kg, and VOCs and metals were below cleanup levels
- 1065EX242 (5.0) - TPHg and TPHd were not detected, TPHfo was detected at 9.4 mg/kg, and VOCs and metals were below cleanup levels.

In 2002, Borings 1065SB103 and -104 were drilled downgradient of two FDS areas (BR8-1) where residual contamination was observed during FDS line removal to evaluate potential impacts to groundwater. Boring 1065SB103 was also drilled and sampled to assess the presence of contaminants in shallow groundwater downgradient of the former ASTs at Building 1040. Boring 1065SB117 was also drilled and sampled in 2002, to evaluate if soil and groundwater beneath Building 1040 contained elevated levels of TPHd, TPHfo, or VOCs.

Sampling results showed that TPHfo and diesel range hydrocarbons were present above applicable cleanup levels in soil at 290 and 2,000 mg/kg, respectively, in soil collected from 1065SB117 at 7.7 feet bgs beneath the west side of Building 1040. Petroleum hydrocarbons in soil at that location may be from leaks in the former FDS lines that entered the building or from the former AST located immediately west of Building 1040 (MACTEC, 2003a). The 2.5-foot sample from Boring 1065SB103 contained TPHfo and TPHd, 2-butanone, and benzene at 220, 59, 0.0076, and 0.0026 mg/kg, respectively. The concentration of TPHfo exceeded the cleanup level in that sample. TPH and VOCs were not detected in the 6.5-foot sample collected from Boring 1065SB103. Only acetone was detected in one of the two soil samples from Boring 1065SB104 at concentrations below cleanup levels.

Contaminated soil in the vicinity of Boring 1065SB103 was excavated during the Phase I IA (discussed below). Confirmation soil sampling for TPHg, TPHd, TPHfo, VOCs showed that residual soil at the perimeter of the excavation met cleanup levels.

TPH and VOCs were detected at concentrations below cleanup levels in the groundwater samples collected from Boring 1065SB117. Groundwater samples from downgradient Borings 1065SB103 and -104 also did not contain TPH, BTEX, or lead above cleanup levels. Based on the absence of

hydrocarbons above cleanup levels in groundwater in the vicinity of the ASTs, it appears residual hydrocarbons in soil in the vicinity of the Building 1040 AST and FDS lines have not adversely affected groundwater (MACTEC, 2003a). Upon completion of the cleanup described in this CAP, the Trust plans to request closure of ASTs 1040.1 and 1040.2 and associated distribution lines including FDS line segment BR8-1.

Removal of USTs 1065.1, 1065.2, 1065.3 – In September 1996, three USTs and associated piping for the Building 1064 service station were removed (MW, 1997a). One confirmation soil sample was collected from the footprint of each UST (1065EX01 through -03; Plate 2) and analyzed for TPH and PAHs using immunoassay analysis. Soil samples were also sent to an offsite laboratory and analyzed for TPHg, TPHd, TPHfo, and VOCs. Sample 1065EX02(10) was also analyzed for lead.

Tables D8 (Appendix D) and Appendix B present analytical results for soil and groundwater samples collected from this area.

TPHg and BTEX were found in soil beneath and northeast of the former USTs at the following maximum detected concentrations:

- TPHg: 1,700 mg/kg;
- Benzene: 0.078 mg/kg;
- Ethylbenzene: 3.6 mg/kg; and
- Xylenes: 7.5 mg/kg.

Detected concentrations of TPHg and benzene exceeded applicable screening levels in the UST excavation confirmation soil samples 1065EX01 and 1065EX03, and in soil samples from four soil borings (1065SB16, 1065SB26, 1065SB110, and 1065SB134) north of the UST excavation. Soil samples collected from downgradient well boring 1065MW9A at 3.5, 6, and 9.5 feet bgs show that TPHg and TPHfo, and TPH unknown diesel were detected above cleanup levels in the 3.5 feet bgs sample at 5,100, 1,100, and 190 mg/kg, respectively. Soil in the vicinity of these former tanks was excavated as part of the Phase I IA (discussed below).

The Phase I IA excavation included the location of former USTs 1065.1, 1065.2, 1065.3. Soil was excavated to Bay Mud and over-excavated where stained soil, petroleum odors, or elevated PID readings were noted or where initial excavation confirmation samples showed TPH or BTEX above cleanup levels. The final excavation depth ranged from 9.0 to 13 feet bgs and final excavation confirmation results collected in the vicinity of the former USTs (1065EX226(11.0)-L, 1065EX213(9.0)-L, and 1065EX228(13.0)-L) showed that residual petroleum hydrocarbons were below cleanup levels. The monitoring well 1065TMW3 was abandoned during the Phase I IA because it was located within an area of soil contamination and lay within the footprint of a proposed water storage tank. The closest downgradient monitoring wells 1065MW9A (shallow groundwater zone) and 1065MW9B (intermediate groundwater zone) show that between October 2002 and June 2003, benzene was detected above the cleanup level (2.66 to 33 µg/L) in samples collected from 1065MW9A. However, since August 2003, benzene has not been detected or below the cleanup levels in groundwater samples collected from 1065MW9A. Between October 2002 and March 2004, TPHg concentrations ranged from 53 to 370 µg/L, but never exceeded cleanup levels. Since March 2004, TPHg has not been detected. Benzene has not been historically detected in intermediate well 1065MW9B and TPH was detected in only one sample collected in November 2002. Upon completion of the cleanup described in this CAP, the Trust plans to request closure of USTs 1065.1, 1065.2, and 1065.3.

Cleaning of Building 1047 Hydraulic Storage Tank and Elevator Pit – There is an elevator in Building 1047. During a site visit in 2002, hydraulic fluid was observed pooled at the base of the elevator. Adjacent to the elevator was an approximate 100-gallon hydraulic fluid reservoir that was approximately one-quarter full. There was a metal pan beneath the reservoir that also contained hydraulic fluid. On October 23, 2002, the Trust supervised removal of hydraulic fluid from the above ground storage tank and elevator pit. The tank and associated piping were found to be in good condition with no visible holes. The concrete below the tank and in the pump pit also appeared to be in good condition (MACTEC, 2003a).

Removal of Building 1062 Hot/Well Sump – Between November 20 and 22, 2002, the Trust supervised the removal of the hot well/sump adjacent to Building 1062. The sump was removed and the concrete, soil, wood forms, and sludge associated with the sump were disposed by Golden Gate Tank Removal under subcontract to the Trust. Sludge was initially removed from the sump and stockpiled on plastic sheeting. The concrete and wood forms comprising the sump floor and southern and western walls of the sump were removed and soil was excavated approximately 2 feet beneath the sump floor. The northern and eastern sump walls were not removed to avoid compromising adjacent structures. The walls of the sump and the wood forms that were removed appeared to be stained and soil surrounding the sump had an odor. The completed sump excavation measured 5- by 10- feet and was approximately 9 feet deep. A soil sample (1065EX138[8.0]) was collected at a depth of 8 feet from the northwest sidewall and a second sample (1065EX133[10.5]) was collected from the excavation floor at an approximate depth of 10.5 feet. After the soil samples were collected, the excavation was backfilled with crushed concrete from the former Letterman Hospital demolition project. Soil samples were submitted to North State Laboratory and analyzed for TPHg, TPHd, TPHfo, Title 22 metals, and VOCs.

Tables D9 and D10 (Appendix D) present analytical results for soil samples collected from this area. Sampling following removal of the hot well/sump indicated that only arsenic was detected in soil (16.3 and 16.4 mg/kg) above the screening level (6.2 mg/kg) at depths of 8 and 10.5 feet bgs, respectively (MACTEC, 2003a). This soil was removed during the Phase I IA (discussed below) and confirmation samples 1065EX214(9.5) and 1065EX247(10.5) were collected from the area after the soil was removed. Samples were analyzed for TPHd, TPHfo, TPHg, VOCs, and Title 22 Metals. Analytical results for these samples showed that there were no cleanup level exceedances.

Boring 1065HP144 was drilled and sampled in August 2003, to evaluate the presence and extent of contaminants downgradient of the waste oil sump. Groundwater samples were collected at two depths, 10 and 25 feet bgs, from the boring. Samples were analyzed for TPHg, TPHd, TPHfo, VOCs, and Title 22 Metals. With the exception of antimony, no chemicals were detected above cleanup levels. It should be noted that because reporting limits were elevated as a result of equipment blank contamination, it cannot be definitively stated whether arsenic was present above cleanup levels in the groundwater samples collected during the August 2003 investigation (MACTEC, 2004a).

Based on the results of the Phase I IA confirmation sampling and the 2003 HydroPunch sampling, it appears there has been no significant impact to soil from past use of this sump and the sump can be closed. Therefore, after completion of the cleanup described in this CAP, the Trust will request closure of the Building 1062 Hot Well/Sump.

Removal of UST 1047.4 – In March 2003, UST 1047.4 was removed from beneath Kendall Drive and three vent lines and 27 feet of product line that led into Building 1047 were also removed. The UST and lines were removed under permit from the City of San Francisco and the UST removal. No other USTs were discovered after tracing all the vent lines and digging several potholes north and south of the UST. Visibly stained soil on the north and south sidewalls of the excavation were removed.

UST removal activities were observed and directed by inspectors from the City of San Francisco Department of Environmental Health (CSFDEH). Following over excavation, two soil samples were collected from the north and south excavation sidewalls (1047EX100[8.5] and 1047EX101[7.0]) and one grab groundwater sample was collected from the excavation (1047GG100) at the direction of the CSFDEH. A third soil confirmation sample (1047EX102[2.5]) was collected on March 14, 2003 from the bottom of the product line trench. Samples 1047EX100(8.5), 1047EX101(7.0), 1047EX102(2.5), and 1047GG100 were analyzed for total petroleum hydrocarbons TPHg, total petroleum hydrocarbons as Stoddard Solvent (TPHss), VOCs, and lead. After excavation confirmation samples were collected, the excavations were backfilled with ~~clean~~ soil from the Letterman Digital Arts Building Excavation ([Letterman Site](#); ~~MACTEC~~, 2003b).

Testing of backfill from the Letterman site in 2005 showed concentrations of chlordane ranging from 6.3 to 32 µg/kg, raising the possibility that the backfill placed in the UST excavation could contain residual levels of chlordane (Trust, 2006). Because pesticides were not identified COCs for the Building 1065 Area, cleanup levels were not selected for chlordane for this site. The Building 1047 UST excavation is located in an area zoned for commercial and recreational use with no ecological use planned. Based on this planned land use, applicable cleanup levels for protection of human health from the Cleanup Level Document (EKI, 2002; Table 7-6 Revised May, 2006) were used to evaluate the suitability of the Letterman site backfill for the Building 1074 UST area. The human health recreational cleanup level for chlordane is 910 µg/kg and the residential cleanup level (for unrestricted use) is 370 µg/kg. Because the lowest applicable cleanup level at the Building 1047 UST area (370 µg/kg) is an order of magnitude higher than the highest reported chlordane concentration from sampled backfill, the possibility that chlordane in the UST backfill exceeds applicable cleanup levels is considered remote and this backfill was considered suitable for the site and was not further tested by the Trust (Trust, 2006).

Tables D11 and D12 (Appendix D) present soil and groundwater samples collected from this area. Excavation soil confirmation sample results were either non-detect or were below cleanup levels for TPHg, TPHss, VOCs, and lead. Analytical results for the grab groundwater sample (1047GG100; Table 2) showed that VOCs and lead were not detected. TPHg was detected at 880 µg/L and TPHss was detected at 510 µg/L. The laboratory reported that the chromatograph corresponding to the 880 µg/L result did not resemble the gasoline standard and that heavier hydrocarbons contributed to the quantification. The reported concentration of TPHg exceeded the Presidio cleanup level of 770 µg/L. There is no level for TPHss. It should be noted that the groundwater sample was collected from the open UST excavation and contained suspended soil particles and therefore, may not truly represent concentrations dissolved in groundwater. To evaluate the presence and concentrations of dissolved organic compounds in groundwater downgradient of the former UST, it was recommended that a shallow groundwater zone monitoring well be installed 10 feet downgradient of the UST excavation.

On November 7, 2003, a monitoring well (1047GW101) was installed to evaluate the presence and concentrations of dissolved organic compounds in groundwater downgradient of the UST excavation. The well was screened in the shallow groundwater zone (5 to 15 feet bgs). The well ~~is~~ has been monitored quarterly as part of the Basewide Groundwater Monitoring Program.

In 2004 Well 1047GW101 ~~is was~~ monitored on a quarterly basis for TPHg, TPHss, and dissolved oxygen and ~~is was~~ sampled annually for BTEX, MtBE, TDS, and metals (arsenic, cadmium, chromium, copper, iron, lead, nickel, and zinc). Only one round of samples has been analyzed metals, two rounds have been analyzed for BTEX and MtBE, and five rounds have been analyzed for TPHg, TPHss. Review of analytical results shows that TPHg, TPHss, BTEX, and MtBE have not been detected and the only detected metals were copper and iron, which were detected below cleanup levels (Appendix B).

Based on the soil excavation confirmation sampling results and groundwater monitoring results of five quarter of groundwater monitoring, which showed TPHg, TPHss, BTEX, MtBE, and lead as nondetect or below cleanup levels, it is recommended that UST 1047.4 be closed. Therefore, after completion of the cleanup described in this CAP, the Trust will request closure of UST 1047.4.

Phase I IA – The Phase I IA was performed to reduce exposure to construction workers and implement cleanup prior to construction of the Trust’s Water Recycling Project at the Building 1065 ~~CAP~~ Area and to remove contamination in soil as part of the Presidio R2-2003-0080. At the Building 1065 ~~CAP~~ Area, the Trust plans to reuse and rehabilitate Building 1063 to house a water treatment plant. The Trust also plans to construct a subsurface recycled water storage tank south of Building 1063.

As part of the Phase I IA, vadose zone soil was removed in and around where the recycled water storage tank and utilities will be installed (Phase I ~~Vadose Zone~~IA Excavation). Soil was removed to Bay Mud, which serves as an aquitard and barrier to the vertical migration of contaminants. The extent of soil removal was limited by the presence of Building 1063 to the north, Building 1062 to the east, and an active sanitary sewer line to south.

As part of the excavation program, Well 1065TMW3A was removed as were the two walls of a former hot well/sump. In addition, during excavation, previously unidentified abandoned underground utility lines, an abandoned sump, a hoist, and a 250-gallon UST (Tank 1065.4) were encountered and removed. The UST was removed under permit from the San Francisco Fire Department (SFFD) and San Francisco Department of Public Health (SFDPH); the UST removal is discussed below.

Three areas containing TPHd and TPHfo in soil were identified in vadose zone soil in the planned location of the Thornberg Road Extension, south of the Phase I ~~Vadose Zone~~IA Excavation. The Phase I IA included excavating soil from these areas (potholes).

After soil was removed from the Phase I ~~Vadose Zone~~IA Excavation and three potholes, confirmation samples were collected from floors and walls of the excavation and from the floors of the potholes. At locations where confirmation sampling from the Phase I ~~Vadose Zone~~IA Excavation showed Phase I IA target chemicals (TPH, BTEX, or lead) exceeding cleanup levels, soil was further excavated vertically and laterally unless the area was limited by building foundations or active subsurface utilities. Analysis of final confirmation samples (1065EX200 through 1065EX202, 1065EX204 through 1065EX207, 1065EX209 through 1065EX218, 1065EX220 through 1065EX226, 1065EX228 and 1065EX229, 1065EX232 through 1065EX237, 1065EX239 through 1065EX248) showed that TPH, BTEX, and lead concentrations were below cleanup levels in soil in the sidewalls and floor of the excavation. Analytical results for final confirmation soil samples are presented on Table D15.

The completed excavation dimensions were approximately 130-by 95-feet and excavation depths ranged from 9 to 12 feet bgs. Based on topographic surveys completed prior to and following the soil removal, an estimated 3,100 cy of soil were removed as part of the Phase I IA. Excavated soil was profiled and transported offsite to Class III (3,069.94 tons of soil; based on bills of lading) and Class II landfills (2,514.31 tons of soil; based on bills of lading). The excavation was backfilled to grade except within the footprint of the proposed water storage tank (*MACTEC, 2004b*).

Removal of UST 1065.4 – On November 19, 2003, a UST (Tank 1065.4) was encountered in the Phase I IA excavation just south of the location of three former diesel and gasoline USTs that were removed in 1996. Soil was removed from around the UST. The tank was cylindrical, constructed of riveted steel, and was 3.2 feet in diameter and 4.0 feet long; no leaks or holes were observed in the UST. Estimated capacity of the UST was 250 gallons. The vent riser and piping had been broken off by the excavator bucket. A photoionization detector (PID) reading taken at the point where the vent riser was previously attached was 55 parts per million (ppm). Fluid was visible through the openings at the top of the tank,

and a stainless steel bailer was lowered into the tank to visually observe the fluid contained in the UST. The fluid in the bailer consisted of water with a strong fuel odor and sheen. There appeared to be a small amount of sediment at the bottom of the tank.

On November 24, 2003, the UST was removed under the supervision of the SFDPH and SFFD. Pea gravel backfill from the former UST footprint and visibly contaminated soil were excavated and removed from the area surrounding and directly underneath the former UST. Confirmation soil sample 1065EX226(11.0) was collected at 11 feet bgs, directly underneath the former UST. The sample was submitted (along with other confirmation samples from the excavation) under chain of custody control to Sequoia Analytical Laboratories for analysis for TPHd, TPHfo, (EPA Test Method 8015M) VOCs (EPA Test Method 8260B), and Title 22 metals (EPA Test Methods 6010/6020/7471).

Table D9 presents a summary of compounds detected in the confirmation sample collected beneath the UST (1065EX226[11.0]). Analytical results for the soil confirmation sample show that TPHg, TPHd, and TPHfo were not detected. Detected concentrations of VOCs and metals were below Presidio cleanup levels. Upon completion of the cleanup described in this CAP, the Trust plans to request closure of UST 1065.4.

Birmingham Road FDS Line Removal – An abandoned 2-inch insulated metal pipe containing fuel oil was discovered by Trust utility crews during construction of a new telecommunications line in Kendall Avenue at the Presidio of San Francisco on July 28, 2004. The line was traced and found to run east-west along Birmingham Road and terminated at the boundary of an excavation completed as part of a Phase I IA (MACTEC, 2004b). Because this line had not been identified during the Phase I FDS investigation, it was not assigned a pipeline designation. Between November 27 and December 1, 2004, the fuel line was removed and contaminated soil around the fuel line was excavated in accordance with the Trust's Petroleum Contingency Plan (PCP; EKI, 2004a). An estimated 525 feet of line was removed, and 207.95 tons of contaminated soil was excavated and disposed at Forward Landfill. Thirteen confirmation soil samples were collected along the fuel line trench and analyzed for TPHd, TPHfo, and PAHs. Where analytical results showed that chemical concentrations in trench confirmation samples exceeded cleanup levels that are protective of groundwater and human health (residential), soil was further excavated and an additional 22 excavation confirmation samples were collected from the walls and floors of the excavations. These excavation confirmation soil samples (1062EX100 through -108 and 1062EX112 through -123) showed that with the exception of soil located between the former Phase I IA excavation and Building 1063 (Sample 1062EX115), contaminated soil was effectively removed such that residual concentrations of PAHs and TPH were below cleanup levels. Soil could not be further excavated at the location of the exceedance at Sample 1062EX115 because of the potential for over-excavation activities to damage the foundation of Building 1063.

To evaluate the potential impacts to groundwater from releases associated with the fuel lines, groundwater samples were collected from four borings (1062HP100 through 1062HP103; Plate 2) that were downgradient of locations where trench confirmation sampling showed exceedances. Analyses of these samples showed that fuel constituents were nondetectable or were detected at concentrations below maximum allowable drinking water levels or environmental screening levels. Accordingly, it appears that releases from the fuel lines have not adversely impacted groundwater quality at the site.

Table D16 presents detected analytical results for final confirmation samples collected from the fuel line trench and excavations and Table D17 presents detected analytical results for the groundwater samples collected from the borings.

Upon completion of the cleanup described in this CAP, the Trust plans to request closure of these fuel lines.

2.4 Site Geology and Hydrogeology

2.4.1 Geology

Plate 5 presents two cross sections prepared using boring logs from previous site characterization programs. The following summarizes MACTEC's interpretation of the soil units encountered at the site based on an interpretation of data from boring logs.

Fill – From review of boring logs, fill material is present from just below the asphalt aggregate at the ground surface to depths of 3.5 to approximately 7.5 feet bgs in the borings drilled at the site. The fill is a heterogeneous mixture of various soil types including clay, silt, sand, and gravel and generally contains anthropogenic debris including brick, concrete, asphalt, wood, metal, wire, and porcelain.

Shallow Sand – Shallow sand is not present in all portions of the site. Where it is present, it consists of clayey or silty sand and silt. This unit varies in thickness in the borings drilled and was generally encountered between depths of 5 to 18.5 feet bgs.

Shallow Bay Mud Aquitard – The shallow Bay Mud underlies the fill or shallow sand deposits and consists of soft silt and fat clay with peat and very fine sand lenses. In the borings drilled for this investigation, the thickness of this unit ranged from 4 to 11.5 feet. The shallow Bay Mud is not present in the southern part of the site.

Shallow Silt Aquitard – In Borings 1065SB104, -117, -124, and -125, and Well 1065MW11B (located at the southern portion of the site) the shallow sand and intermediate sand units are separated by silt, sandy silt, or silt with sand. This fine-grained unit ranges in thickness from 1 to 3 feet. This unit may represent Colma Formation.

Intermediate/Shallow Sand – Clayey sand, silty sand, and sand layers were encountered between 12.5 and 18 feet bgs within the shallow Bay Mud in Borings 1065SB118, -123, and Well 1065MW9B. These borings and wells are located in the north-central portion of the site. This unit is not continuous and is probably hydraulically connected with the intermediate sand unit.

Upper Intermediate Sand (Formerly Intermediate Sand) – This unit underlies the shallow silt or shallow Bay Mud at depths ranging from 16 to 22.5 feet bgs. Except for Boring 1065SB118, where interlayered silt and silty sand were encountered, this unit consists of silty sand in the borings drilled for the 2002 investigation.

Intermediate Bay Mud (Not observed) – The intermediate Bay Mud that was identified in previous investigations was not observed in the three deeper (40- to 45-feet) borings drilled during MACTEC's 2002 investigation (MACTEC, 2003a). The only fine grained unit observed during drilling was a silt lense that was encountered at 35.5 feet bgs in Boring 1065SB106 and at 38 feet bgs in 1065SB124.

Lower Intermediate Sand (Formerly Deep Sand) – Silty sand was encountered to a depth of 45 feet bgs in 1065SB106 and to 41.5 feet bgs in Boring 1065SB124. In Boring 1065SB123, a sandy silt was encountered at a depth of 38.5 feet bgs – this may represent the bottom of the sand unit. Because no fine grained unit (other than a silt lense) was encountered between the top of the intermediate sand and 38.5 feet bgs, in the borings drilled by MACTEC, what was formerly identified as “the deep sand” is now identified as the “lower intermediate sand” because it appears to be part of the same lithologic unit and is in hydraulic connection with the “upper intermediate sand”.

Summary

Fill is present throughout the site but the underlying shallow sand unit is not present at all locations. The shallow sand or fill units are underlain by a fine-grained aquitard consisting of shallow Bay Mud or silt, sandy silt, or silt with sand. The shallow Bay Mud appears to be confined to the northern portion of the site and in the southern part of the site the aquitard is dominantly comprised of silt (Cross section A-A'; Plate 5). The transition between Bay Mud and the silt aquitard probably represents a facies change between Beach Dune and Colma Formation.

In the borings drilled by MACTEC, the underlying intermediate sand unit is dominantly composed of silty sand. Because the intermediate Bay Mud was not encountered in the borings drilled for this investigation, there does not appear to be a separate (deep) groundwater zone below 28 feet bgs. The "intermediate sand" therefore, appears to extend to depths of 38.5 feet bgs or deeper.

2.4.2 Hydrogeology

On the basis of the lithologic logging, water level monitoring, and chemical analytical results, two primary hydrogeologic units have been identified at the site: a shallow groundwater zone and an intermediate groundwater zone. Lithologic data obtained from borings drilled by MACTEC indicate units that had been previously identified as the shallow/intermediate groundwater zone, intermediate groundwater zone, and deep groundwater zone appear to be in hydraulic connection and should be considered as one hydrogeologic unit, identified as the "intermediate groundwater zone." As illustrated on the geologic cross sections shown on Plate 5, there does not appear to be a continuous aquitard separating the shallow/intermediate sand and intermediate sand or an aquitard separating what was formerly identified as the "intermediate" and "deep" sand units (now referred to as "upper intermediate sand" and "lower intermediate sand"). In addition to these lithologic data, chemical analytical results for what was formerly identified as "intermediate" and "deep" groundwater zone samples (now referred to as "upper intermediate" and "lower intermediate" groundwater zone samples) do not show significant concentration changes with depth, suggesting that there is hydraulic connection between these units.

In contrast to the shallow/intermediate and lower intermediate sands, the shallow and intermediate groundwater zones are separated by fine-grained units that appear to serve as aquitards. These units change in nature between the northern and southern parts of the site. In the northern part of the site, the aquitard consists of Bay Mud that ranges in thickness from 4 to 11.5 feet. In the southern part of the site, the aquitard is thinner and consists of 1 to 3 feet of silt, sandy silt, or silt with sand. The following describes the two groundwater zones.

Shallow Groundwater Zone – This zone consists of saturated portions of the fill and, where present, the shallow sand. Historically, shallow groundwater elevations have ranged from 7.31 to 15.77 feet above PLLW. Groundwater in the shallow groundwater zone is unconfined and the First and Second Quarter 2004 potentiometric maps indicate that groundwater flow in the shallow zone is to the northeast at a gradient of 0.02 feet per foot (ft/ft) consistent with historical trends (*T&R, 2004b*).

Intermediate Groundwater Zone – This zone consists of the intermediate/shallow sand, upper intermediate sand, and lower intermediate sand (identified in previous reports as deep sand). Wells screened in the intermediate sand unit show that it is confined to semiconfined. Comparison of water levels in adjacent shallow zone and intermediate zone well pairs shows that there is an upward vertical gradient between the intermediate and shallow groundwater zones in the northern and central portions of the site. The hydraulic head difference is greatest in the northeastern portion of the site (historically ranging from 1.36 to 4.50 feet; Well pairs 1065PZ1A/B, 1065MW9A/B, 1065PZ2A/B), suggesting the aquitard is most effective in this area at creating confining groundwater conditions. In the southernmost

portion of the site, where the shallow aquitard comprises of silt instead of Bay Mud, groundwater in the intermediate zone is semiconfined (water levels stabilized above the elevation of the intermediate sand where the wells were screened). In the vicinity of well pair 1065PZ3A/B, located in the southern part of the site, there is a downward vertical gradient of up to 0.05 foot between the upper and intermediate groundwater zones because groundwater elevations levels in the intermediate zone wells are lower than groundwater levels the shallow zone wells.

Historically, intermediate groundwater elevations have ranged from 8.84 to 15.80 feet above PLLW. The First and Second Quarter 2004 potentiometric maps indicate that groundwater flow in the intermediate zone was generally north, with groundwater flow trending to the northeast on the eastern portion of the site and northwest on the western portion of the site at gradients ranging 0.008 and 0.006 ft/ft, respectively, and is consistent with historical trends (*T&R, 2004b*).

Between February and July 2003, a large excavation was dewatered at the Letterman Digital Arts Building construction project, southeast of the site (*T&R, 2004b*). Between March and August 2003, groundwater levels in onsite wells declined below the lowest previously measured groundwater elevations, indicating that the dewatering activities at the Letterman had affected local groundwater at the site (*T&R, 2004b*). Groundwater elevations rose in the fourth quarter 2003, likely in response to groundwater recharge from precipitation as well as cessation of excavation dewatering at the adjacent site.

2.5 Source, Nature, and Extent of Contamination

This section describes contaminants present in soil and groundwater at the site, based on data collected during site investigations, corrective actions, and as part of the groundwater monitoring program. The data evaluated include analytical results for corrective action soil confirmation samples and all soil samples from borings and exploratory trenches that fall outside of corrective action boundaries. ~~This evaluation focuses on current site conditions. The most recent year of g~~Groundwater monitoring data ~~from (2004)~~ and ~~the most recent (2003)~~ grab HydroPunch groundwater data from 2003 are used to assess the ~~current~~ nature and extent of contamination in groundwater. Earlier groundwater monitoring and HydroPunch data are not considered to be representative of ~~current-site groundwater~~ conditions as significant contaminant source areas were removed during previous corrective actions and chemicals in groundwater may have naturally attenuated over time. Historical groundwater data are reviewed in terms of whether they show chemical concentration trends over time. Discussions of the nature and extent of contamination have been subdivided into four specific areas of the site because each of the areas represents distinct source areas and are separated by physical site features. The four areas of the site are:

- The parking area in the vicinity of former Building 1066;
- The area between, south, and east of Buildings 1040 and 1047;
- Building 1040 and the area between Building 1040 and Building 1063; and
- Building 1027.

2.5.1 Soil

Chemicals present in soil at the Building 1065 Area include:

- TPHg, TPHd, and TPHfo, unknown diesel range hydrocarbons

- PAHs – acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(b+k) fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, and pyrene
- Metals – antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc. Of these metals, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, vanadium, and zinc exceeded background for Beach Dune Sand, the primary native soil encountered at the site
- VOCs – acetone, BTEX, 2-butanone, bromoform, carbon disulfide, chloroethane, dibromochloromethane, 2-hexanone, methylene chloride, and 1,1,2,2-tetrachloroethane.

Analytical results for organic compounds and metals detected in soil samples are posted on Plates 6 and 7. Plates 9 and 10 show petroleum hydrocarbons detected in soil in two depth intervals – 1 to 5 feet and 5 to 10 feet bgs. Contours presented are cleanup levels for petroleum hydrocarbons assuming that groundwater is within 5 feet of contaminated soil, and for samples within the ecological protection zone, the more stringent of levels protective of ecological receptors or protective of groundwater (assuming a separation of less than 5 feet between contaminated soil and groundwater). Groundwater monitoring data are presented in Appendix B. Historical analytical results for soil samples collected from the site are presented in Appendix C. Tables 1 and 2 present a summary of chemicals detected in soil in (1) the portion of the site that is designated as a freshwater protection zone – the most stringent of cleanup levels protective of groundwater, ecological and human health receptors apply and (2) the portion of outside of the freshwater zone – the most stringent of cleanup levels protective of groundwater and human health apply (non-ecological cleanup levels). In the case of metals, if the residential human health and ecological cleanup levels are less than background for Beach Dune sand, then background levels are used as the cleanup level. The tables also list, for each chemical, the cleanup levels that apply in each area. Cleanup levels for petroleum hydrocarbons are dependent on the depth of groundwater below the sample. Different cleanup levels are used for samples (1) within 5 feet of groundwater and (2) greater than 5 feet from groundwater. Selection of [Cleanup-cleanup Levels-levels](#) is further discussed in Section 3.2.

2.5.1.1 Parking Area in Vicinity of Former Building 1066

The parking area in the vicinity of Former Building 1066 includes the following potential contaminant source areas:

- Wash rack at former Building 1066;
- Former paint shop at Building 1048;
- Former crematory (Building 50); and
- Fill Site 6B.

As shown on Plate 6, a portion of the ecological freshwater protection zone is located within this area of the site. Buffer zone cleanup levels are also applicable in the western and northern portions of the parking area based on Figure 7-2 in *Development of Presidio-Wide Cleanup Levels for Soil Sediment, Groundwater and Surface Water* (Cleanup Level Document; EKI, 2002; [Table 7-6 Revised May, 2006](#)). Thus, cleanup levels for the FEPZ and ecological buffer zone cleanup levels were used to evaluate chemical analytical samples collected within the western and northern portions of the parking area.

Groundwater in the parking area is considered to be within 5 feet of soil contamination, and accordingly, the more stringent of the cleanup levels for protection of groundwater apply in this area. Cleanup levels were exceeded at the following locations within the FEPZ and in areas designated as ecological buffer zone in the parking area in the vicinity of former Building 1066:

- 1065SB132 – TPHfo at 600 mg/kg, TPHd at 190 mg/kg, benzo(a)pyrene at 0.075 mg/kg, cadmium at 1.9 mg/kg, selenium at 0.64 mg/kg, and lead at 310 mg/kg at 2 feet bgs; and cadmium at 1.9 mg/kg and selenium at 0.63 mg/kg at 5.5 feet bgs;
- 1065SB114 – TPHfo at 420 mg/kg, unknown hydrocarbons in the diesel range at 120 mg/kg,; TPHfo at 930 mg/kg, TPHd at 200 mg/kg, barium at 690 mg/kg, cadmium at 1.4 mg/kg, zinc at 970 mg/kg, selenium at 0.61 mg/kg, and lead at 560 mg/kg at 6 feet bgs;
- 1065SB113 – TPHfo at 430 mg/kg, unknown hydrocarbons in the diesel range at 180 mg/kg;
- 1065SB120 – TPHfo at 390 mg/kg, unknown hydrocarbons in the diesel range at 130 mg/kg at 2.5 feet bgs;
- 1065SB30 – TPHfo at 300 mg/kg, TPHd at 202 mg/kg, and TPHfo at 250 mg/kg and TPHd at 420 mg/kg in a field duplicate sample at 3 feet bgs;
- 1065SB14 – TPHfo at 163 mg/kg at 7.3 feet bgs;
- 1065SB22 – TPHfo at 170 mg/kg at 3 feet bgs;
- 1065PZ4A – TPHfo at 150 mg/kg at 3 feet bgs; and
- 1065SB29 – TPHfo at 220 mg/kg at 4 feet bgs in a split sample.

The samples collected from areas outside of the FEPZ and ecological buffer zone were evaluated using only human health cleanup levels and cleanup levels protective of groundwater quality. Groundwater in this area is considered to be within 5 feet of soil contamination, and accordingly, the more stringent of the cleanup levels for protection of groundwater apply in this area. Cleanup levels were exceeded at the following locations outside of the FEPZ and ecological buffer zone in the parking area in the vicinity of former Building 1066:

- 1065TP129 (Test Pit A1) – TPHfo at 170 and lead at 590 mg/kg at 5.5 feet bgs;
- 1065SB111 – TPHfo at 1,300 mg/kg at 2.5 feet bgs, unknown hydrocarbons in the diesel range at 320 mg/kg at 2.5 feet bgs;
- 1065SB13 – Benzene at 0.037 mg/kg at 7.2 feet bgs;
- 1065SB112 – Lead at 4,200 mg/kg at 5.5 feet bgs; and
- 1065EX50 – TPHfo at 220 mg/kg at 5 feet bgs.

Detected VOCs included 2-butanone, acetone, carbon disulfide, 1,1,2,2-tetrachloroethane, benzene, ethylbenzene, dibromochloromethane, and bromoform. There were no cleanup level exceedances for VOCs other than benzene, and no exceedances for PAHs other than benzo(a)pyrene. Samples collected from this area were not analyzed for dioxins because no evidence of ash was seen in the soil collected in the vicinity of the crematory.

Petroleum hydrocarbons were detected at various depths and locations throughout this area. Plates 9 and 10 illustrate the extent of TPH in this area using the most stringent applicable cleanup levels as isoconcentration contours. These plates illustrate that petroleum hydrocarbons above screening levels are not associated with specific petroleum source areas but are present throughout the area. The areal extent of petroleum hydrocarbons in this area is not fully characterized.

Samples from Borings 1065SB114, -121, and -132 were analyzed for Title 22 metals. As previously stated, there were cleanup level exceedances for cadmium, zinc, lead, and barium in soil. These metals may be derived from petroleum hydrocarbons or may be contaminants in the debris fill underlying the area. These metals may also be from releases from the paint shop at former Building 1068 because the cleanup level exceedances for zinc and barium were found in the soil samples from Boring 1065SB114, located in the footprint of former Building 1068.

With the possible exception of metals detected in the borings drilled at the former crematory and paint shop, exceedances for metals, specifically lead, TPHfo, TPHd, benzene, and benzo(a)pyrene in soil do not appear to be at any specific horizon or location relative to identified potential source areas associated with past use of the site (wash rack and UST at former Building 1066, former paint shop, and former crematory). TPH does not appear to be correlated to lead contamination as the highest TPH concentrations were not associated with the highest lead concentrations. The occurrence of benzene at concentrations exceeding cleanup levels in soil appears to be limited in extent as there was only one cleanup level exceedance, and a sample collected from a boring adjacent to the exceedance showed benzene concentrations below the cleanup level.

Metals can be derived from petroleum hydrocarbons as trace constituents in fuels or in waste oil, from paints, or from past vehicle maintenance activities at the site. Metals may also be from non-native fill, anthropogenic debris associated with Fill Site 6B, and from particulates from burning. Although PAHs are a component of petroleum hydrocarbon fuels, they could also be derived from other sources such as asphalt fragments, vehicle exhaust, particulates from burning, or contaminated fill associated with Fill Site 6B which has been mapped in this area. Debris fill containing cast iron pipe, clay pipes, bricks, concrete, metal, wood, wire, asphalt fragments, were noted in logs and trenches drilled in the area. Petroleum hydrocarbons are likely from incidental spillage from vehicles parked or serviced in the area, that may have been moved around and buried during demolition of buildings and re-grading of the site. Metals and PAHs released to surface soil could have been similarly redistributed in fill areas during site demolition and grading activities.

2.5.1.2 Area Between, South, and East of Buildings 1040 and 1047

This area includes the following potential source areas:

- Former FDS lines that ran along Edie Road ([FDS line segments BR8-1 and BR16-1](#)); and
- The former laundry facility at Building 1047, including the Stoddard solvent UST formerly located along the east side of Building 1047.

The following chemicals were detected in this area at the indicated concentrations:

- TPHfo – 17 to 350 mg/kg;
- TPHd or unknown diesel hydrocarbons – 17 to 94 mg/kg;
- Benzo(a) pyrene – 0.029 mg/kg;

- 2-Butanone – 0.013 mg/kg;
- Acetone – 0.0041 to 0.0056 mg/kg; and
- Lead – 1.4 to 2.9 mg/kg.

Applicable cleanup levels in this area are those protective of human health and drinking water quality. Detected concentrations did not exceed applicable cleanup levels. Pesticides were not detected in soil samples collected from the two borings (1065SB109 and 1065MW11A) that were analyzed for pesticides.

Benzo(a)pyrene may be residual contamination from a release from the FDS lines or it may also be derived from other sources such as asphalt fragments in debris fill underlying the area. Petroleum hydrocarbons could be present in soil as a result of spills of motor oil or fuel from vehicles or releases from the former FDS lines.

The highest concentrations of TPH in this area were detected in Boring 1065SB109, where TPHfo and unknown diesel hydrocarbons were detected at 350 and 94 mg/kg, respectively in a sample collected at 3 feet bgs. TPH was not detected in the 6-foot sample collected from this boring. Plate 9 shows the estimated 160 mg/kg isoconcentration contour for TPHfo around Boring 1065SB109. In this area, depth to groundwater is greater than 5 feet below detected contamination. Therefore, for TPH, less stringent cleanup levels apply for groundwater (depth to groundwater in Well 1065MW11A has ranged from 9.24 to 12.3 feet below top of casing). In this case, the most conservative applicable cleanup levels for TPHfo and TPHd are human health residential cleanup levels of 1900 mg/kg for TPHfo and 1380 mg/kg for TPHd. TPH concentrations for soil samples collected from this area did not exceed these cleanup levels.

Based on the results of chemical analysis of soil samples collected south of and between Buildings 1040 and 1047, it does not appear there is contamination in this area from pesticides or chlorinated solvents potentially used at the former laundry facility at Building 1047 and TPH concentrations were below applicable cleanup levels.

The following soil and groundwater confirmation soil samples were collected during UST 1047.4 removal activities:

- Two soil samples were collected from the north and south excavation sidewalls (1047EX100[8.5] and 1047EX101[7.0]);
- A third soil confirmation sample (1047EX102[2.5]) was collected from the bottom of the product line trench; and
- One grab groundwater samples were collected from the excavation (1047GG100).

Excavation soil confirmation sample results were either non-detect or were below cleanup levels for TPHg, TPHss, VOCs, and lead. Based on the soil excavation confirmation sampling results which showed TPHg, TPHss, BTEX, MtBE, and lead as nondetect or below cleanup levels, it appears that UST 1047.4 has not significantly impacted soil in this area.

2.5.1.3 Building 1040 and Area between Buildings 1040 and 1063

This area contains the following potential source areas:

- Former Building 1040 AST and FDS lines ([FDS line segment BR8-1](#));

- Incinerator, Maintenance, and Paint Shop at Building 1065;
- Hot Well/Sump Adjacent to Building 1062; and
- Former Building 1065 USTs.

The incinerator, maintenance, and paint shop at Building 1065, hot well/sump at Building 1062, the Former Building 1065 USTs, and some of the former FDS lines fell within the boundary of the Phase I IA excavation (Section 2.3.2). Accordingly, contaminated soil and groundwater associated with these potential source areas were removed from the site during the Phase I IA. Confirmation sampling for TPHg, TPHd, BTEX, and Title 22 metals showed that contaminant concentrations remaining in soil in these areas met cleanup levels. Confirmation sampling did not include analysis for dioxins and furans because samples from soil borings drilled in 2002 in the vicinity of the former incinerator (1065SB119, -107, and -108) were analyzed for dioxins and furans and calculated 2,3,7,8-tetrachlorodibenzo-p-dioxin-toxicity equivalent (TCDD-TE) concentrations for samples collected from those borings did not exceed the cleanup level for tetrachlorodibenzo-p-dioxin (*MACTEC, 2003a*). Because dioxin and furan concentrations in shallow soil were below the cleanup level, there appears to be no significant impact to soil from past use of the incinerator at Building 1065. Cleanup levels applicable to this area are human health and groundwater quality assuming that petroleum contamination is within 5 feet of groundwater. The following locations contain chemicals at concentrations exceeding cleanup levels:

- 1065PZ1A - Benzo(a)pyrene at 0.11 mg/kg at 5.5 feet bgs;
- 1065SB115 - Benzo(a)pyrene at 0.081 and 0.12 mg/kg at 2.5 and 6.5 feet bgs, respectively;
- 1065SB135 - Cadmium at 2.1 mg/kg, zinc at 85 mg/kg; cadmium at 2.5 mg/kg and benzene at 0.052 mg/kg at 8 feet bgs; and cadmium at 2.4 mg/kg at 12 feet bgs;
- 1065MW9A - TPHg at 5,100 mg/kg, TPHfo at 1,100 mg/kg, TPHd at 190 mg/kg, benzene at 0.126 mg/kg, and lead at 120 mg/kg at 3.5 feet bgs; and benzene at 0.025 mg/kg at 6 feet bgs;
- 1065SB117 - TPHfo at 290 mg/kg and unknown diesel range hydrocarbons at 2,000 mg/kg at 7.7 feet bgs;
- 1065SB141 - Lead at 630 mg/kg at 4.0 feet bgs; TPHg at 30,000 mg/kg, benzene at 2.4 mg/kg, ethylbenzene at 28 mg/kg, toluene at 3.7 mg/kg, 2-hexanone at 730 mg/kg at 6.5 feet bgs;
- 1065SB143 - TPHfo at 300 mg/kg, lead at 800 mg/kg, arsenic at 6.1 mg/kg at 3.5 feet bgs; and arsenic at 6.1 mg/kg at 6.5 feet bgs;
- 1065SB140 - Arsenic at 6.4 mg/kg at 3.5 feet; and
- Excavation Confirmation Sample 1062EX115 - TPHd at 150 mg/kg and TPHfo at 360 mg/kg at 3.5 feet bgs.

Isoconcentration contours for TPH in soil (Plates 9 and 10) show three areas of petroleum hydrocarbon contamination (1) beneath Building 1063 (1065SB141 and 1065SB143) in unsaturated-capillary fringe (3.5 to 4.0 feet bgs) and saturated soil samples (6.5 feet bgs), (2) between the Phase I IA excavation and Building 1063 (1062EX115) in unsaturated soil at 3.5 feet bgs, and (3) adjacent to and below the west side of Building 1040 (1065SB117) in saturated soil at 7.7 feet bgs. Contamination in each of these three areas is further discussed below.

- 1) Petroleum hydrocarbon contaminated soil beneath Building 1063 is likely the downgradient extent of a contaminant plume that extended north (downgradient) of the former Building 1065 USTs. The petroleum hydrocarbons detected at this location could also be from past releases from the former FDS lines that ran east-west along Birmingham Road and also ran north-south between Buildings 1040 and 1063 (un-named FDS segment).
- 2) Petroleum hydrocarbon contaminated soil at confirmation sample 1062EX115 is likely the result of a release from the former FDS line that ran along Birmingham Road.
- 3) Petroleum hydrocarbons detected in the soil sample at Boring 1065SB117 on the west side of Building 1040 may be from past leaks in the former FDS lines (BR8-1) that entered the building or from the former AST located immediately west of Building 1040.

The only PAH detected above cleanup levels in this area was benzo(a)pyrene in soil samples from 1065SB115 and 1065PZ1A. These exceedances were not associated with TPH above cleanup levels. Both of these borings are north of Building 1063 near the eastern limit of Fill Site 6B. It is possible that the benzo(a)pyrene detected in soil in this area may be associated with fill material (e.g., asphalt debris in the fill) or may be from residual petroleum hydrocarbons related to the adjacent hydrocarbon plume.

Metals detected at concentrations exceeding cleanup levels included, cadmium (2.1 to 2.5 mg/kg), arsenic (6.1 to 6.4 mg/kg), and lead (630 to 800 mg/kg). Metals may be related to contaminants in the fill or from metals associated with fuels, motor oil, and vehicle maintenance activities at former Building 1065.

2.5.1.4 Building 1027

This area contains the following potential source areas:

- Former fuel oil UST.

Cleanup levels applicable to this area include human health, FEPZ, and for TPH cleanup levels protective of groundwater quality assuming a distance between contamination and groundwater of less than 5 feet. Two confirmation soil samples collected from the former UST 1027 excavation (CENTEREAST and NORTHEAST) contained low concentrations (1.6 and 1.4 mg/kg) of unknown hydrocarbons. TPHd and BTEX were not detected in soil. Low levels of metals were detected in all three samples (CENTEREAST, NORTHEAST, and SOUTHEAST).

Review of data collected in the vicinity of the former UST indicates that cleanup levels were not exceeded for soil samples collected from this area. Accordingly, it appears there is no significant impact to soil from the former fuel oil UST.

2.5.2 Groundwater

As previously discussed, the most recent available 2004 groundwater monitoring data and 2003 grab groundwater data were considered when assessing the current nature and extent of contaminants in groundwater at the site. Although chemicals of concern and RUs will be identified on the basis of the most recent 2004 groundwater monitoring data, historical groundwater monitoring data were also evaluated to obtain a better picture of how contaminant concentrations have changed over time and to assess whether previous corrective actions and dewatering activities have affected the concentrations and distribution of chemicals in groundwater at the site. The data used to evaluate the current nature and extent of contamination are analytical results for groundwater samples collected from monitoring wells in 2004 and grab groundwater samples collected from borings drilled and sampled in 2003. Table 3 presents a statistical summary of analytical samples collected from monitoring wells in 2004. Separate summaries

are provided for wells located inside the FEPZ, and wells located outside of the FEPZ, because different cleanup levels apply, depending on location. Table 4 presents a statistical summary of chemicals detected in the 2003 HydroPunch groundwater samples. Chemicals detected in the last four quarters of during the 2004 groundwater monitoring program are posted on Plate 8. The discussion focuses on areas of the site and potential specific source areas to assess whether they may have contributed to elevated levels of chemicals observed in groundwater. Chemicals detected in shallow and intermediate groundwater at the site include:

- TPHg and TPHd;
- Metals – antimony, arsenic, barium, chromium, copper, lead, molybdenum, nickel, and vanadium; and
- VOCs – acetone, BTEX, 1,1,1-trichloroethane (1,1,1-TCA), 1,1,2-trichloroethane (1,1,2-TCA), 2-butanone, 2-hexanone, bromodichloromethane, carbon disulfide, chloroform, MtBE, PCE, and vinyl acetate.

The only chemical detected above cleanup levels in groundwater samples collected from monitoring wells and piezometers in 2004 was arsenic. Chemicals detected above cleanup levels in 2003 HydroPunch samples included TPHg, benzene, arsenic, and antimony.

As previously discussed, contaminants detected in groundwater are discussed for each of the four areas of the site.

2.5.2.1 Nature and Extent of Contamination in Groundwater

Chemicals detected in shallow and intermediate groundwater at the site include:

- TPHg and TPHd;
- Metals – antimony, arsenic, barium, chromium, copper, lead, molybdenum, nickel, and vanadium; and
- VOCs – acetone, BTEX, 1,1,1-trichloroethane (1,1,1-TCA), 1,1,2-trichloroethane (1,1,2-TCA), 2-butanone, 2-hexanone, bromodichloromethane, carbon disulfide, chloroform, MtBE, PCE, and vinyl acetate.

The only chemical detected above cleanup levels in groundwater samples collected from monitoring wells and piezometers in 2004 was arsenic. Chemicals detected above cleanup levels in 2003 HydroPunch samples included TPHg, benzene, arsenic, and antimony.

2.5.2.1 Groundwater at Parking Area in Vicinity of Former Building 1066

The parking area in the vicinity of Former Building 1066 includes the following potential contaminant source areas:

- Wash rack at former Building 1066;
- Former paint shop at Building 1048;
- Former crematory (Building 50); and

- Fill Site 6B.

Piezometers located in this area include the following:

- Shallow and intermediate zone piezometers 1065PZ7A and 1065PZ7B located upgradient of the former paint shop and crematory; and
- Shallow and intermediate zone piezometers 1065PZ4A and 1065PZ4B which are located in the footprint of the former paint shop and generally downgradient of the crematory.

~~Both piezometer pairs are in the area mapped as Fill Site 6B.~~ These ~~wells~~ piezometers fall within the FEPZ, so the most stringent of cleanup levels for protection of ecological and human health receptors at drinking water standards apply. ~~Wells~~ These piezometers have been monitored since 1997 for TPHg, TPHd, TPHfo, BTEX, and MtBE, TDS, and iron. Groundwater samples were analyzed for selected metals (arsenic, cadmium, chromium, copper, lead, nickel, and zinc) once in 2000 and again in 2004.

Piezometers 1065PZ7A and 1065PZ7B - TPHg, TPHd, TPHfo, BTEX, and MtBE were not detected in groundwater samples collected from these piezometers in 2004. These wells ~~are~~ have been only monitored annually. Review of seven years of historical data (Appendix B) show that TPHg, TPHd, TPHfo, BTEX, and MtBE have not been historically detected in groundwater samples collected from the two piezometers. In March 2004, copper was detected at 2.1 µg/L in 1065PZ7A and chromium, copper, and iron were detected at 31, 3.3, and 120 µg/L respectively, in 1065PZ7B. Detected concentrations were below cleanup levels.

Piezometers 1065PZ4A and 1065PZ4B - Review of 2004 groundwater monitoring data shows that TPHd, TPHg, BTEX and MtBE were not detected in 1065PZ4A and 1065PZ4B. These wells have been ~~are currently being~~ monitored annually. Review of historical monitoring results (Appendix B) shows that TPHg, TPHfo, BTEX, and MtBE have not been historically detected in groundwater from 1065PZ4A. There were only two detections of TPHd in 1065PZ4A over the ~~last~~ seven years of groundwater monitoring – at 56 µg/L in June 1998 and at 140 µg/L in September 2001. Detected concentrations did not exceed the applicable cleanup level of 443 µg/L. TPHd has not been detected in 1065PZ4A since September 2001. TPHg, TPHd, TPHfo, BTEX, and MtBE have not been historically detected in Piezometer 1065PZ4B.

Review of metals data shows that arsenic was detected at 14 µg/L in 1065PZ4A in 2000 and 2004 groundwater samples. The detected concentration exceeded the applicable cleanup level for arsenic of 10 µg/L. Chromium and copper were detected at 24 and 2.3 µg/L, respectively in the 2004 groundwater sample collected from 1065PZ4B. Detected concentrations did not exceed cleanup levels of 50 and 11.8 µg/L for chromium and copper, respectively. Iron was not analyzed in 2000 or 2004. Historical concentrations of iron ranged 14,300 to 25,600 µg/L in 1065PZ4A, and iron has not historically been detected in 1065PZ4B.

There are no wells or piezometers located downgradient of the wash rack at Building 1066, but HydroPunch samples collected in 2002 showed that detected TPH and VOCs in shallow and intermediate zone groundwater samples did not exceed cleanup levels in groundwater samples collected from a boring 1065SB121 drilled at the location of the former wash rack. Therefore, it appeared that there had been no significant impact to groundwater from past use of the wash rack at this location.

Summary

Based on 2004 groundwater monitoring results, it appears that the only chemical detected above cleanup levels in the parking area in the vicinity of former Building 1066~~this area~~ is arsenic. As discussed in further detail in Section ~~2.5.2.2~~ 2.5.3, arsenic is believed to be present in shallow groundwater primarily due to reducing conditions favorable to mobilizing arsenic from iron coatings of soil particles in the native sand or fill material into groundwater—not due to a release of arsenic-containing materials at the site.~~groundwater because of combination of locally reducing conditions in groundwater caused by the degradation of organic matter in the underlying Bay Mud and/or degradation of petroleum hydrocarbons and a source of arsenic in the native sand or fill material overlying the Bay Mud and not from a release of metals at the site.~~ Accordingly, there does not appear to be a significant impact to groundwater in this area from past use of the site for vehicle maintenance, painting, or as a crematory.

2.5.2.2 Groundwater at Area Between, South and East of Buildings 1040 and 1047

This area includes the following potential source areas:

- Former FDS lines that ran along Edie Road (FDS line segments BR8-1 and BR16-1); and
- The former laundry facility at Building 1047, including the Stoddard Solvent UST formerly located along the east side of Building 1047.

Piezometers and monitoring wells located in this area include the following:

- Shallow and intermediate zone piezometers 1065PZ6A and 1065PZ6B located upgradient of the fuel lines, laundry facility, and former Stoddard Solvent UST;
- Shallow and intermediate zone piezometers 1065PZ3A and 1065PZ3B located downgradient of the FDS lines;
- Shallow and intermediate zone Wells 1065MW11A and 1065MW11B located downgradient of the fuel lines and adjacent to former water storage tanks at Building 1047;
- Shallow zone Well 1047MW101 downgradient of the former Building 1047 Stoddard Solvent UST; and
- Shallow and intermediate zone piezometers 1065PZ5AR and 1065PZ5AB located downgradient of the Building 1047 laundry facility.

Piezometer 1065PZ6A, 1065PZ6B, 1065PZ3A, 1065PZ3B, and 1065PZ5AB have been monitored since 1997 and Piezometer 1065PZ5AR has been monitored since August 2003 for TDS, iron, TPHg, TPHd, TPHfo, BTEX, and MtBE. Well 1047MW101 has been monitored since January 2003 for TPHg, TPHss, VOCs, TDS, and iron. Groundwater samples were analyzed for selected metals (arsenic, cadmium, chromium, copper, lead, nickel, and zinc) once in 2000 and again in 2004. This area is outside of the FEPZ and the ecological buffer zone; therefore, only levels protective of human health at drinking water standards apply.

Piezometers 1065PZ6A and 1065PZ6B - Review of 2004 groundwater monitoring data shows that TPHd, TPHg, BTEX, and MtBE were not detected in groundwater samples collected from 1065PZ6A and 1065PZ6B. These wells are currently have been monitored annually. Review of historical monitoring data (Appendix B) shows that TPHd was detected twice in 1065PZ6A - at 480 µg/L in March 1999 and at

51 µg/L in May 1999, below the cleanup level of 880 µg/L; and TPHfo was detected once – at 430 µg/L in March 1999, below the cleanup level of 1200 µg/L. TPH has not been detected in 1065PZ6A since May 1999. TPHg, TPHd, TPHfo, BTEX, and MtBE have not been historically detected in 1065PZ6B. Review of metals data shows that chromium was detected in 1065PZ6A at 43 and 30 µg/L in July 2000 and March 2004 groundwater samples, respectively. Detected concentrations did not exceed the cleanup level of 50 µg/L. Chromium and zinc were also detected at 42 and 24 µg/L in 1065PZ6B in 2004. Detected concentrations were below cleanup levels of 50 and 5,000 µg/L, respectively. Arsenic was not detected. As discussed in Section 2.5.2.2, the presence of chromium and absence of arsenic suggest ~~slightly~~relatively oxidizing conditions may be present in the vicinity of these wells.

Piezometers 1065PZ3A and 1065PZ3B - Review of 2004 groundwater monitoring data shows that TPHd, TPHg, BTEX and MtBE were not detected in groundwater samples collected from 1065PZ3A and 1065PZ3B. Chromium was detected in both piezometers at 23 and 33 µg/L, respectively during 2004. Arsenic was not detected. As discussed in Section 2.5.2.2, the presence of chromium and absence of arsenic suggest ~~slightly~~relatively oxidizing conditions may be present in the vicinity of these wells. Copper was also detected in 1065PZ3A at 1.3 µg/L during 2004. Detected concentrations did not exceed cleanup levels. Review of historical monitoring data (Appendix B) shows that TPHd was detected in 1065PZ3A at 59 µg/L in May 1999. In 1065PZ3B, TPHd was detected at 67 µg/L in May 1999 and at 110 µg/L in September 2001. Detected concentrations were below the cleanup level of 880 µg/L. TPH has not been detected in those wells since September 2001.

Wells 1065MW11A and 1065MW11B - Review of 2004 groundwater monitoring data shows that TPHd, TPHg, BTEX and MtBE were not detected in groundwater samples collected from 1065MW11A and 1065MW11B. These wells ~~are~~have been monitored annually. Review of historical groundwater monitoring data (Appendix B) shows that MtBE was detected in 1065MW11A in August and December 2003 at 3.7 and 19 µg/L. MtBE was also detected in 1065MW11B in December 2003 at 3.1 µg/L. In November 2002, TPHd was detected in 1065MW11B at 96 µg/L (below the cleanup level of 880 µg/L), but has not been detected since that time. Review of metals data shows that chromium was detected at 12 and 40 µg/L, respectively, in groundwater samples collected in 2004 from 1065MW11A and 1065MW11B. Detected concentrations did not exceed the cleanup level of 50 µg/L. Arsenic was not detected. As discussed in Section 2.5.2.2, the presence of chromium and absence of arsenic suggest ~~that~~relatively oxidizing conditions may be present in the vicinity of these wells.

Well 1047MW101 - Review of 2004 and historical monitoring (2003) analytical results shows that TPHg, TPHss, BTEX, and MtBE have not been detected in 1047MW101 and the only detected metals were copper and iron, which were detected at 1 and 100 µg/L. The detected concentration did not exceed the cleanup level for copper of 1,000 µg/L. There is no cleanup level for iron. Arsenic and chromium were not detected in groundwater samples collected from this well.

Piezometers 1065PZ5AR and 1065PZ5B - Review of 2004 groundwater monitoring data shows that TPHd, TPHg, BTEX, and MtBE were not detected in groundwater samples collected from 1065PZ5AR and 1065PZ5B. These wells ~~are~~have been monitored annually. Review of historical monitoring data (Appendix B) shows that toluene was detected once at 0.62 µg/L in March 2002 and TPHd was detected once at 66 µg/L in June 1998. Detected concentrations did not exceed cleanup levels of 150 µg/L for toluene, and 880 µg/L for TPHd. No other organic chemicals have historically been detected in those piezometers. Review of metals data show that arsenic was detected at 22 µg/L in the groundwater sampled collected in March 2004. The detected concentration exceeded the cleanup level of 10 µg/L. No other metals were detected in the March 2004, groundwater sample. As discussed in Section 2.5.2.2, the presence of arsenic and absence of chromium indicates reducing groundwater conditions in the vicinity of 1065PZ5AR.

Summary

Review of ~~the~~ 2004 data shows that only arsenic was detected above cleanup levels in groundwater samples collected from monitoring wells and piezometers in in the area between, south and east of Buildings 1040 and 1047~~this area~~. As discussed in further detail in Section 2.5.3, the Trust has conducted a study to further evaluate the presence of arsenic in groundwater and its relationship to petroleum hydrocarbons, soil types, and groundwater chemistry at the Building 1065 Area, and two neighboring CAP sites—the Building 207/231 Area and the Commissary/PX Area. The results of this study were published in the Technical Memorandum, Evaluation of Arsenic and Other Metals in Groundwater at Three Corrective Action Plan Sites, Presidio of San Francisco (MACTEC, 2006). Based on results of the study, arsenic is believed to be present in groundwater at elevated concentrations at these sites primarily due to the reducing conditions caused by degradation of petroleum hydrocarbons in saturated soils.~~arsenic is believed to be present in groundwater because of combination of locally reducing conditions in groundwater caused by the degradation of organic matter in the underlying Bay Mud and/or degradation of petroleum hydrocarbons and a source of arsenic in the native sand or fill material overlying the Bay Mud. It should be noted that arsenic was not detected in conjunction with petroleum hydrocarbons in wells in this area and therefore, other factors that affect groundwater redox conditions, (such as proximity to Bay Mud) may be affecting the solubility of arsenic in this area. To date, only one year of arsenic data have been collected. As additional data are collected, the relationship between arsenic concentrations, hydrocarbons, Bay Mud, or other factors that affect redox conditions will be further evaluated and the conceptual model for the presence of dissolved arsenic in groundwater will be refined.~~

The only chemical historically detected above cleanup levels was MtBE, which was detected in 1065MW11A in August and December 2003 at 3.7 and 19 µg/L. There is no known onsite source of MtBE in this area. In *T&R, 2003*, it was suspected that MtBE may have been caused by runoff and use of internal combustion engines. Accordingly, it appears that there is no significant impact to groundwater from the former laundry facility, FDS lines, and Stoddard Solvent UST in this area.

2.5.2.3 Groundwater at Building 1040 and Area Between Buildings 1040 and 1063

This area contains the following potential source areas:

- Former Building 1040 AST and FDS lines (FDS line segment BR8-1 and un-named segment);
- Incinerator, Maintenance, and Paint Shop at Building 1065;
- Hot Well/Sump Adjacent to Building 1062; and
- Former Building 1065 USTs.

Piezometers and monitoring wells located in this area include the following:

- Wells 1065MW10A and 1065MW10B located cross-gradient of former Building 1040 FDS lines (BR8-1) and upgradient of the Phase I IA excavation;
- Piezometers 1065PZ2A and 1065PZ2B located downgradient of the former FDS lines along Birmingham Road and crossgradient of the Phase I IA excavation;

- Wells 1065MW9A and 1065MW9B located downgradient of the maintenance and paint shop at Building 1065 and downgradient of the Former Building 1065 USTs and the Phase I IA excavation;
- Piezometers 1065PZ1A and 1065PZ1B located downgradient of the maintenance and paint shop at Building 1065 and downgradient of the Former Building 1065 USTs and Phase I IA excavation; and
- Wells 1065MW101 and 1065MW102, located downgradient of the maintenance and paint shop at Building 1065 and downgradient of the Former Building 1065 USTs and the Phase I IA excavation.

Piezometers 1065PZ2A, 1065PZ2B, 1065PZ1A, and 1065PZ1B have been monitored since 1997 and Wells 1065MW9A, 1065MW9B, 1065MW10A, and 1065MW10B have been monitored since October 2002. Wells 1065MW101 and -102 have been monitored since August 2004. Samples have been analyzed for TDS, iron, TPHg, TPHd, TPHf, BTEX, and MtBE. The initial two sampling rounds from 1065MW9A, 1065MW9B, 1065MW10A, and 1065MW10B were analyzed for VOCs. Groundwater samples were analyzed for selected metals (arsenic, cadmium, chromium, copper, lead, nickel, and zinc) once in 2000, and again in 2004. This area is outside of the FEPZ and the ecological buffer zone; therefore, only levels protective of human health at drinking water standards apply.

Wells 1065MW10A and 1065MW10B – These wells are upgradient of the Phase I IA area. Review of 2004 groundwater monitoring data shows that TPHd, TPHg, BTEX and MtBE were not detected in groundwater samples collected from Wells 1065MW10A and 1065MW10B. These wells ~~are~~ have been monitored annually. Review of historical groundwater monitoring data (Appendix B) shows that MtBE was detected at 2.4 µg/L in a groundwater sample collected in August 2003 from 1065MW10A and was also detected at 7.5 µg/L in a sample collected in December 2003 from 1065MW10B. Review of metals data show that no metals were detected in 1065MW9B in 2004. Chromium and copper were detected at 26 µg/L and 1.2 µg/L, respectively in 1065MW10B. Detected concentrations did not exceed cleanup levels.

Piezometers 1065PZ2A and 1065PZ2B – These wells are cross-gradient of the Phase I IA excavation area. Review of 2004 groundwater monitoring data shows that TPHd, TPHg, BTEX, and MtBE were not detected in groundwater samples collected from Piezometers 1065PZ2A and 1065PZ2B. These wells ~~are~~ currently have been monitored annually. Review of historical groundwater monitoring data (Appendix B) shows that MtBE was detected at 2.4 and 5.0 µg/L, respectively in groundwater samples collected from 1065PZ2A in May and August 2004. Review of metals data shows that arsenic was detected at concentrations of 16 µg/L to 19 µg/L during the first three quarters of 2004 (exceeding the cleanup level of 10 µg/L). Concentrations declined to 6.8 µg/L in the fourth quarter of 2004. In general, zinc is not commonly detected at the site, but was detected in Piezometer 1065PZ2A in the December 2004 at 88 µg/L, below the cleanup level of 5,000 µg/L. Iron concentrations in 1065PZ2A have ranged from 3,300 to 16,000 µg/L. Iron concentrations showed similar decline as was observed with arsenic in the December 2004 groundwater sampling event. Iron was not detected in groundwater samples collected from 1065PZ2B. Arsenic has not been detected in conjunction with the detection of TPH in groundwater samples collected from this piezometer.

As discussed in further detail in Section 2.5.3, based on results of a study to further evaluate the presence of arsenic in groundwater (MACTEC, 2006), arsenic is believed to be present in groundwater at elevated concentrations at these sites primarily due to reducing conditions caused by degradation of petroleum hydrocarbons in saturated soils. well. If the arsenic was present as a result of reducing conditions caused by the degradation of organic matter in the underlying Bay Mud, one would expect that the concentrations

~~would be relatively constant over time; the decrease in concentrations observed in December 2004 does not fit the model of reducing conditions caused by proximity to Bay Mud. It should be noted that based on the limited data collected from this well (one year of data), it is not known if these concentration changes are seasonal, representative of a long-term trend, or within the variability of the aquifer and sampling or analytical test methods. As additional data are collected, the relationship between arsenic concentrations, hydrocarbons, Bay Mud, or other factors that affect redox conditions will be further evaluated and the conceptual model for the presence of dissolved arsenic in groundwater will be refined. Iron was not detected in groundwater samples collected from 1065PZ2B.~~

Wells 1065MW9A and 1065MW9B – These wells are downgradient of the Phase I IA area. Review of 2004 groundwater monitoring data shows that TPHd, TPHfo, and BTEX were not detected in Well 1065MW9A and TPHg, TPHd, TPHfo, and BTEX were not detected in Well 1065MW9B. TPHg was detected in Well 1065MW9A at 53 µg/L in March 2004, below the cleanup level of 880 µg/L. Review of historical data (Appendix B) shows that between October 2002 and June 2003, benzene was detected above the cleanup level (2.66 to 33 µg/L) in samples collected from 1065MW9A. However, since August 2003, benzene has been nondetect or below the cleanup levels in groundwater samples collected from 1065MW9A. This decline in concentrations was coincident with a decline in groundwater elevations caused by the Letterman Digital Arts excavation dewatering. Groundwater at the site was apparently being captured by the cone of depression created by the nearby excavation dewatering. The decline in contaminant concentrations could be the result of water levels dropping below the smear zone, where petroleum hydrocarbons are adsorbed to soil particles, and/or movement of contaminated groundwater toward the cone of depression created by the excavation dewatering. This dewatering was conducted prior to implementation of the Phase I IA, in which contaminated soil was removed by excavation. Monitoring of 1065MW9A downgradient of the Phase I IA excavation showed that benzene continued to remain below cleanup levels or nondetect following the Phase I IA excavation even after groundwater levels rose and groundwater flow resumed its normal pattern in response to cessation of dewatering at the Letterman Digital Arts excavation. Between October 2002 and March 2004, TPHg concentrations ranged from 53 to 370 µg/L in 1065MW9A, but never exceeded cleanup levels. Since March 2004, TPHg has not been detected. Toluene has only been detected in one sample collected in March 2003 at 0.59 µg/L. Xylenes were historically been detected in 1065MW9A at concentrations ranging from 0.6 to 5 µg/L, but have not been detected since August 2003. Detected concentrations of toluene and xylenes were below cleanup levels. As a result, it appears that excavation of soil containing petroleum hydrocarbons was effective in reducing petroleum hydrocarbon concentrations in groundwater to below cleanup levels.

Review of metals data show that in 2004 arsenic was detected at concentrations ranging from 6.9 to 9.6 µg/L in 1065MW9A, below the 10 µg/L cleanup level. The presence of arsenic in groundwater in this well could be indicative of reducing conditions related to the former hydrocarbon plume upgradient of the well ~~or~~ from degradation of organic matter in the underlying Bay Mud. Copper was also detected in 1065MW9A at 19 µg/L, below the 1,000 µg/L cleanup level. Lead was detected in a sample collected in October 2002 from Well 1065MW9A, but has not been detected since that time. Iron concentrations in 1065MW9A have ranged from 5,400 to 5,700 µg/L.

TPHd, TPHfo, BTEX, and MtBE have not been historically detected in Well 1065MW9B. TPHg was detected in only one sample collected in November 2002 at 120 µg/L, below the 770 µg/L cleanup level. Review of metals data shows that chromium was detected in 1065MW9B at concentrations ranging from 29 to 33 µg/L, below the 50 µg/L cleanup level. Iron was not detected in samples collected from 1065MW9B.

Piezometers 1065PZ1A and 1065PZ1B – These wells are downgradient of the Phase I IA excavation and downgradient of an area of petroleum-contaminated soil below Building 1063. Review of 2004 groundwater monitoring data shows that for groundwater samples collected from 1065PZ1A, TPHg was

detected three times at concentrations ranging from 200 to 230 µg/L, toluene was detected once at 1.9 µg/L, ethylbenzene was detected once at 1.2 µg/L, xylenes were detected twice at 0.78 and 0.76 µg/L, and MtBE ~~were was~~ detected twice at 3.8 and 3.0 µg/L. Detected concentrations were below cleanup levels. All analytes were not detected in the Fourth Quarter 2004 sampling event. Review of historical groundwater monitoring data (Appendix B) shows that toluene (1.2 to 2.4 µg/L) and ethylbenzene (0.52 to 1.2 µg/L) have been sporadically detected at concentrations below cleanup levels (150 µg/L for toluene and 300 µg/L for ethylbenzene). Xylenes and TPHg have been consistently detected throughout the monitoring program. Total xylene concentrations have ranged from 0.58 to 0.96 µg/L, below the cleanup level of 1750 µg/L. TPHg concentrations have ranged from 76 to 310 µg/L, below the cleanup level of 770 µg/L. TPHg, TPHd, TPHfo, BTEX, and MtBE have not been historically detected in Piezometer 1065PZ1B.

Review of metals data shows that during the first three quarters of 2004, arsenic was detected in samples from 1065PZ1A at concentrations ranging from 16 µg/L to 23 µg/L, above the cleanup level of 10 µg/L. Detected concentrations are consistent with concentrations detected in this well in July 2000 (18 µg/L). Arsenic was not detected in the sample collected from 1065PZ1A in December 2004. Copper was detected at 1.1 µg/L in the sample collected from 1065PZ1A in March 2004. Iron concentrations in this well have ranged from 280 to 18,000 µg/L, with the lowest concentration detected in December 2004. The decline in TPHg, iron, and arsenic concentration observed in 1065PZ1A in December 2004 could be the result of removal of a portion of the hydrocarbon source during the Phase I IA excavation program or may represent a temporal fluctuation in chemical concentrations.

As discussed in further detail in Section 2.5.3, based on results of a study to further evaluate the presence of arsenic in groundwater (MACTEC, 2006), arsenic is believed to be present in groundwater at elevated concentrations at these sites primarily due to reducing conditions caused by degradation of petroleum hydrocarbons in saturated soils. As additional data are collected, the relationship between arsenic concentrations, hydrocarbons, or other factors that affect redox conditions will be further evaluated and the conceptual model for the presence of dissolved arsenic in groundwater will be refined. The only metal detected in intermediate groundwater zone well 1065PZ1B was iron, which was detected at concentrations considerably lower (105 to 330 µg/L) than have been measured in 1065PZ1A.

Wells 1065MW101 and 1065MW102 – These wells are downgradient of the Phase I IA excavation and downgradient of an area of petroleum-contaminated soil below Building 1063. Review of two quarters of data collected in August and December 2004 shows that only carbon disulfide was detected in 1065MW102 at 2 µg/L; there is no cleanup level for carbon disulfide. Review of metals data shows that ~~in~~ arsenic was detected above cleanup levels in both rounds of samples collected from both wells – at 25 and 21 µg/L in 1065MW101 and at 11 and 16 µg/L in 1065MW102. Although petroleum hydrocarbons were not detected in groundwater samples collected from the two wells, the wells are located downgradient of a hydrocarbon plume. Copper was detected at 1.1 µg/L and nickel was detected at 25 µg/L in the August 2004 sample collected from 1065MW101. Copper and nickel were also detected in the August 2004 sample collected from 1065MW102 at 11 and 25 µg/L, respectively. Copper, nickel, and zinc concentrations were below their respective 1,000, 5,000, and 100 µg/L cleanup levels. Iron was detected at 4,000 µg/L and 13,000 µg/L in 1065MW101 and at 150 µg/L and 570 µg/L in 1065MW102.

Grab Groundwater Sampling – Grab groundwater samples were collected from the shallow and intermediate groundwater zone from Soil Borings 1065SB139, 1065SB141, and 1065SB143 in August 2003 to evaluate the presence and extent of groundwater contamination beneath Building 1063. TPHg, TPHfo, unknown hydrocarbons in the diesel range, 1,1,1-TCA, 1,1,2-TCA, 2-butanone, 2-hexanone, acetone, BTEX, bromodichloromethane, chloroform, PCE, arsenic, barium, chromium, cobalt, and molybdenum were detected in groundwater. Of these compounds, benzene was detected in one sample (1065SB143[10]) at 14 µg/L, above the 1 µg/L cleanup level. Antimony was detected in five

samples at concentrations ranging from 6.3 to 15 µg/L, above the 6 µg/L cleanup level. TPHg was detected at concentrations ranging from 96 to 8,000 µg/L. Cleanup levels ~~for TPHg~~ were exceeded in the 10-foot samples collected from Borings 1065SB141 (1,000 µg/L) and 1065SB143 (8,000 µg/L). Petroleum hydrocarbons detected in groundwater beneath Building 1063 are likely derived from a release from former Building 1065 USTs. Groundwater samples collected from Boring 1065SB135 in 2002 showed TPHg at 450 µg/L and benzene at 16 µg/L in shallow groundwater (12 feet bgs) just south of Building 1063 (Plate 11). The detected concentration of benzene exceeded the cleanup level of 1 µg/L.

Summary

Review of 2004 groundwater monitoring data and 2003 HydroPunch data shows that TPHg, benzene, antimony, and arsenic have been detected above cleanup levels in the shallow groundwater zone ~~in at Building 1040 and the area between Buildings 1040 and 1063~~~~this portion of the site~~. Except for antimony, there have not been any cleanup level exceedances in samples collected from the intermediate groundwater zone. Plate 11 shows isoconcentration contours for TPHg and benzene in the shallow groundwater zone. TPH and BTEX detected in groundwater in this area are likely the downgradient end of a hydrocarbon plume originating from the former Building 1065 USTs. Although historical monitoring data have shown benzene above cleanup levels in Well 1065MW9A, located downgradient of the former Building 1065 USTs, benzene has been below cleanup levels since August 2003. TPHg, ethylbenzene, toluene, and xylenes have also shown a similar decrease in concentrations in Well 1065MW9A. The decreasing TPHg and BTEX concentrations observed in Well 1065MW9A are coincident with a decline groundwater elevations observed at the site that was likely the result of excavation dewatering at an adjacent construction site (T&R, 2003). This dewatering preceded the Phase I IA excavation. However, monitoring of 1065MW9A showed that benzene continued to remain below cleanup levels or was nondetect following the Phase I IA excavation even after groundwater levels rose and groundwater flow resumed its normal pattern in response to cessation of dewatering at the Letterman Digital Arts excavation.

TPHg was not detected in Piezometer 1065PZ1A in December 2004 for the first time in 27 quarters of sampling. The reduction in concentrations may also be a result of removal of significant quantities of contaminated soil as part of the Phase I IA. It should be noted that TPH concentrations may increase in this well in future sampling events because residual hydrocarbons are still present in soil and beneath Building 1063, upgradient of Piezometer 1065PZ1A.

Arsenic has been detected above cleanup levels in this area, but as discussed previously, arsenic is believed to be present as a result of reducing conditions in the local groundwater. Three of the four wells with arsenic concentrations above cleanup levels are located within or downgradient of a hydrocarbon groundwater plume. ~~Arsenic concentrations were not monitored prior to 2004, so the effect of groundwater dewatering and the Phase I IA on arsenic concentrations cannot be evaluated.~~ In December 2004, arsenic concentrations declined from 23 µg/L to nondetect in 1065PZ1A, but were detected in adjacent wells 1065MW101 and 1065MW102, also downgradient of the USTs, at 21 µg/L and 11 µg/L, respectively. Arsenic concentrations also showed a similar decline in 1065PZ2A. Arsenic concentrations in these wells will continue to be monitored to evaluate any changes in concentrations over time.

It should be noted that although 1065MW10A is underlain by Bay Mud, arsenic was not detected in samples collected from this well. It is possible that the absence of metals detected in this well relative to other wells in the shallow groundwater zone could be a function of local variations in metals concentrations in soil underlying the site or other geochemical factors affecting groundwater geochemistry.

As discussed in further detail in Section 2.5.3, based on results of a study to further evaluate the presence of arsenic in groundwater (MACTEC, 2006), arsenic is believed to be present in groundwater at elevated concentrations at these sites primarily due to reducing conditions caused by degradation of petroleum hydrocarbons in saturated soils.

Only one round of arsenic data have been collected from this well and additional data need to be collected to better understand the relationship between arsenic, soil types, and petroleum hydrocarbons.

Antimony was detected above cleanup levels in groundwater samples collected from borings drilled in the vicinity of Building 1063 in 2003. In the First Quarter 2005, antimony was added to the groundwater monitoring program for this site to further evaluate the presence and concentrations of antimony in groundwater in this area. Results of the first quarter sampling will be evaluated in the CAP Work Plan show that antimony was not detected in wells at concentrations exceeding cleanup levels (T&R, 2005b).

2.5.2.4 Groundwater at Building 1027

This area contains the following potential source areas:

- Former fuel oil UST.

Monitoring wells 1027MW01 and 1027MW02 are located in this area. No groundwater samples were collected from these wells in 2004. Review of historical sampling results shows that petroleum hydrocarbons were not detected in samples collected from 1027MW01 and 1027MW03 during groundwater monitoring events conducted between July 1995 and April 1996; these wells are screened across both shallow and intermediate groundwater zones.

Based on groundwater sampling results from previous groundwater monitoring programs, which show contaminant concentrations below cleanup levels, it appears past use of the fuel oil UST at Building 1027 has not impacted the local groundwater quality.

2.5.2.5 Occurrence of Metals in Groundwater

Review of 2004 groundwater monitoring data shows that there is a fairly consistent pattern with respect to the distribution of arsenic, iron, and chromium in groundwater. Arsenic was only detected in groundwater samples from the shallow groundwater zone and is absent in groundwater samples in the intermediate zone. Arsenic detections appear to be confined to the northern portion of the site, which is underlain by Bay Mud. There also seems to be higher iron concentrations in shallow groundwater zone wells in this portion of the site and iron is noticeably absent or was detected at lower concentrations in intermediate groundwater zone wells. In contrast, chromium has primarily been detected in the intermediate groundwater zone across the site, and in shallow groundwater in the southern portion of the site, but has not been detected in shallow groundwater in the northern portion of the site. It should be noted that not all wells underlain by Bay Mud show elevated arsenic concentrations. One sample collected from 1065MW10A, which was underlain by Bay Mud, did not contain detectable concentrations of arsenic. It should be noted that arsenic was also detected above cleanup levels in three wells (1065MW101A, 1065MW102A, and 1065PZ1A) downgradient of a hydrocarbon plume. The presence and occurrence of these metals in groundwater is further discussed below.

Arsenic

A possible mechanism for dissolution of naturally-occurring arsenic in soil is the reduction of iron and manganese oxides/hydroxides on which the arsenic is adsorbed. Under reducing conditions, iron III is reduced to iron II, manganese IV is reduced to manganese II, and arsenate (arsenic V) to arsenite (arsenic III). Because the reduced forms of these metals are less adsorptive (more soluble), increased concentrations of iron II, manganese II, and arsenic III would be expected under reducing groundwater conditions.

Metals and TPH groundwater data collected from the Building 1065 Area were evaluated to assess whether the presence of arsenic in groundwater is affected by reducing conditions. There appears to be a correlation between arsenic and markers of reducing conditions (iron) and strong negative correlations between arsenic and markers of oxidizing conditions (DO), suggesting that higher arsenic concentrations were associated with localized reducing conditions. These conditions could cause the reduction of ferric (iron III) iron oxyhydroxides present in the aquifer matrix, resulting in the liberation of adsorbed arsenic to groundwater.

These data were spatially analyzed and from this analysis, it appeared that elevated historical methane concentrations and ~~more recent~~ (2004) iron and arsenic concentrations were associated with areas underlain by Bay Mud, which would be expected to contribute to reducing conditions from degradation of organic materials within the Bay Mud. It is plausible that arsenic adsorbed onto iron oxyhydroxides in the sands and fill are being reduced and solubilized by reducing conditions present near the Bay Mud, liberating the arsenic to groundwater. It is also likely that reducing conditions are locally influenced by degradation of petroleum hydrocarbons. This is supported by the observation that three of the six wells with arsenic exceedances are located downgradient of a hydrocarbon plume and arsenic exceedances appear to be related to former petroleum hydrocarbon releases at the Commissary/PX Study Area (T&R, 2004a).

As discussed in further detail in Section 2.5.3, based on results of a study to further evaluate the presence of arsenic in groundwater (MACTEC, 2006), arsenic is believed to be present in groundwater at elevated concentrations at these sites primarily due to reducing conditions caused by degradation of petroleum hydrocarbons in saturated soils.

~~It should be noted that the evaluation of arsenic in groundwater is based on only one year of groundwater monitoring. As previously discussed, there are data that do not fit into the two working models for the presence of arsenic in groundwater; specifically:~~

- ~~• There are wells underlain by Bay Mud where arsenic was not detected in groundwater; and~~
- ~~• There are wells with elevated arsenic that are not associated with a hydrocarbon plume.~~

~~In addition, changes in arsenic concentrations at a single monitoring point need to be evaluated in the framework of more than one hydrologic cycle, so that variations in concentrations can be evaluated in terms of long term trends, seasonal fluctuations, or assess whether they fall within the expected range of concentrations based on the aquifer and sampling and analytical methods. Additional rounds of samples are necessary to evaluate the relationship between arsenic concentrations, the hydrocarbon plume, Bay Mud, or other factors that affect redox conditions and therefore, the solubility of arsenic in groundwater.~~

Chromium

As previously discussed, chromium is present in the intermediate groundwater zone and in shallow groundwater in the southern part of the site where Bay Mud is absent. Spatial analysis of the chromium, methane, arsenic, and DO data shows that areas where elevated levels of chromium have been detected correlate with areas where parameters indicative of oxidizing conditions. The solubility of chromium is generally favored by high dissolved oxygen concentrations because chromium displays greater mobility (lessened adsorption) in the more oxidized hexavalent form over the more reduced trivalent form. Insoluble trivalent chromium is expected to occur where groundwater conditions are reducing from naturally occurring organic matter in Bay Mud or anthropogenic organic matter (petroleum hydrocarbons). Therefore, the absence of chromium in the northern portion the site is consistent with our current model that reducing conditions exist in shallow groundwater in this area of the site (where Bay Mud is present).

Chromium concentrations are higher in the southwest portion of the site, which suggests that the source of chromium may be located to the southwest. Army studies have shown that chromium is naturally occurring where groundwater contacts serpentinite rocks (*MW, 1999 in EKI, 2002; Table 7-6 Revised May, 2006*). It is likely that the chromium detected in groundwater at the site has migrated downgradient from serpentinite located in upland areas.

2.5.3 Conceptual Model of Nature and Extent of Contamination

The following [section](#) presents the conceptual model [based on](#) ~~for~~ our current understanding of the nature and extent of contaminants at the site.

Based on previous investigations and corrective actions, there appear to be three primary areas where contaminants were released to surface, ~~or~~ subsurface soil, [or groundwater](#) at the site.

- Area between Building 1065 and Building 1063;
- Area west of Building 1040; and
- Parking area west of Building 1063.

The [conceptual model of the nature and extent of contamination at these areas](#) are discussed below, [followed by a discussion of the presence of arsenic in groundwater at the site.](#)

Area between Building 1065 and Building 1063 – Contaminants in this area include TPHg, TPHd, TPHf, BTEX, 2-hexanone, PAHs, and metals. Petroleum hydrocarbon contamination between Building 1065 and Building 1063 appears to be primarily derived from former leaking gasoline and diesel USTs as well as past use of sumps and FDS lines in this area. Metals and PAHs may also be derived from past use of an incinerator or from debris fill present in the area. In this area, the more mobile contaminants (TPHg, TPHd, and BTEX) migrated downward through the vadose zone until they reached shallow groundwater. These contaminants adsorbed onto soil particles as they migrated downward through the soil profile. Once they reached groundwater, the contaminants migrated downgradient with groundwater as both a free phase on the groundwater surface and as a dissolved phase (free phase product was historically measured in well 1065TMW3). As the groundwater level fluctuated (in response to recharge or lack of recharge from rainfall) and as water was drawn upward by capillary forces in the soil, contaminants from groundwater adsorbed onto soil particles just above the water table (capillary fringe or smear zone). Based on sampling in this area, contamination is vertically confined to fill and shallow sand comprising the shallow aquifer that overlies Bay Mud. Bay Mud appears to have been effective in

preventing the vertical migration of contaminants because contaminants were either not detected or were detected at lower concentrations in the intermediate groundwater zone than in the shallow groundwater zone. For example, benzene was detected at concentrations up to 33 µg/L in shallow zone well 1065MW9A, but it was not detected in adjacent intermediate zone well 1065MW9B. In addition, contamination appears to be limited in horizontal extent, because monitoring of downgradient piezometer 1065PZ1A, located just north of Building 1063, has not shown TPH or BTEX above cleanup levels.

Groundwater monitoring performed prior to and following dewatering and removal of contaminated soil as part of the Phase I IA in this area has shown that lowering water levels below the smear zone, extracting groundwater, and subsequent removal of contaminated soil has been effective at reducing petroleum hydrocarbons in groundwater to concentrations below cleanup levels. For example, in Well 1065MW9A, concentrations of benzene ranged from 2.66 to 33 µg/L between October 2002 and June 2003. After dewatering in 2003 and removal of contaminated soil between November 2003 and January 2004, benzene concentrations in Well 1065MW9A were nondetect or below the cleanup level of 1 µg/L.

Area west and beneath Building 1040 – Contaminants in this area include heavy hydrocarbons. Petroleum contamination in this area appears to be primarily derived from releases of fuel oil to surface and subsurface soil from fuel oil ASTs and FDS lines. Fuel oil released to surface and shallow soil in this area appears to have migrated vertically to a silt layer as contamination appears to be confined to fill and sand overlying the silt unit. Contaminated soil was removed from this area and some residual contamination remains beneath Building 1040.

Parking area west of Building 1063 – Contaminants in this area include TPHd, TPHfo, PAHs, and metals. Petroleum hydrocarbon contamination in this area is likely from incidental spillage from vehicles parked or serviced in the area. Metals may have been derived from petroleum hydrocarbons as trace constituents in fuels or in waste oil, from paints, from past vehicle maintenance activities at the site, from non-native fill, anthropogenic fill debris, or from particulates from burning. PAHs could also be from a variety of sources including petroleum hydrocarbons, debris fill, or from particulates from past use of the crematory in this area. Based on their distribution at various locations and depths throughout the area that are not always coincident with identified potential source areas, it appears that the petroleum hydrocarbons, PAHs, and metals in soil were likely moved around and buried during demolition of buildings and re-grading of the site. Samples collected from groundwater wells in this area show that because of the relatively low solubility of contaminants present in the soil, contaminants (except for arsenic) are not present in groundwater at concentrations exceeding cleanup levels.

Arsenic in Groundwater—Arsenic is present above cleanup levels in six shallow groundwater monitoring wells located in the northern portion of the site. All wells are underlain by Bay Mud. Three of the wells with arsenic exceedances are located downgradient of a hydrocarbon plume, the other three wells are not coincident with detections of petroleum hydrocarbons in groundwater. Previous background studies show that arsenic is naturally-occurring present in Beach Dune Sand which occurs in the shallow groundwater zone; providing a native source of the arsenic detected in groundwater.

Review of one year of monitoring data shows that there appears to be a correlation between arsenic and markers of reducing conditions (iron) suggesting that higher arsenic concentrations are associated with localized reducing conditions. These conditions could cause the reduction of ferric (iron III) iron oxyhydroxides present in the aquifer matrix, resulting in the liberation of adsorbed arsenic to groundwater. One likely mechanism for localized reducing conditions is degradation of petroleum hydrocarbons from former releases at the site and ~~or~~ organic matter in the Bay Mud underlying the shallow groundwater zone in the northern portion of the site. The correlation between reducing conditions and elevated levels of arsenic in groundwater have been noted at ~~three~~ other petroleum CAP

sites; Building 207/231 Area, Building 1349 Area, and the Commissary/PX /CAP Study Area (MACTEC, 2005b; BBL, 2005; and T&R, 2004a).

Based on results of a study to further evaluate the presence of arsenic in groundwater and its relationship to petroleum hydrocarbons, soil types, and groundwater chemistry at the Building 1065 Area, and two neighboring CAP sites—the Building 207/231 Area and the Commissary/PX Area, the following conclusions provide a framework for the conceptual model of the nature and extent of arsenic contamination in shallow groundwater at the site:

- Reducing conditions are present in shallow groundwater at the Building 1065 Area;
- Petroleum releases appear to be a primary factor that creates reducing conditions favorable to dissolving arsenic from iron-oxide soil coatings into groundwater;
- Once the arsenic dissolves into groundwater, arsenic concentrations remain relatively stable over time; and
- When the petroleum source and reducing conditions abate, arsenic concentrations may tend to slowly decrease due to dilution, dispersion, and transport.
- Additional data are planned to be collected as part of the ongoing groundwater monitoring program to further refine our understanding of factors affecting the occurrence and distribution of dissolved arsenic in groundwater at this site.

3.0 SUMMARY OF SITE RISKS AND IDENTIFICATION OF REMEDIAL UNITS

This section presents processes used to identify chemical of concern (COCs) that are present in soil and groundwater at concentrations that pose a risk to human health, the environment, and drinking water quality. RUs are identified as those areas where COCs are present at concentrations above cleanup levels protective of human health and the environment. The remedial units thus identified will be targeted for cleanup in this CAP.

3.1 Remedial Action Objectives (RAOs)

It is important to establish RAOs prior to identifying COCs, RUs, and selecting corrective action alternatives. The RAOs for the Building 1065 Area cleanup program include:

- Protection of human health and the environment;
- Cost-effective cleanup of the site consistent with its potential land use;
- Recycling excavated materials such as concrete and asphalt to the extent practicable;
- Compliance with State and Federal environmental laws;
- Consistency of the selected corrective action alternatives at the site with the overall transformation of the Presidio into a national park site; and
- Preference for permanent (“clean closure”) remedies whenever practicable, cost-effective, and consistent with current or anticipated land use.

3.2 Identification of Cleanup Levels

This section discusses cleanup levels that are used to identify locations of the Building 1065 Area that may require potential remedial action based on chemical concentrations measured in soil and groundwater during previous investigations at the site (*MACTEC, 2003a*).

Cleanup levels for petroleum-related constituents in soil and groundwater at the Presidio were originally developed in the Fuel Product Action Level Development Report (FPALDR; *MW, 1995b*). In Order No. 96-070 (*RWQCB, 1996*), the RWQCB adopted the FPALDR soil cleanup levels as SCRs for petroleum hydrocarbons and related constituents in soil at the Presidio. These SCRs were maintained in the later the RWQCB Order (*RWQCB, 2003*). Since the issuance of the FPALDR and SCRs, cleanup levels for the Presidio have been proposed in the Cleanup Level Document (*EKI, 2002; Table 7-6 Revised May, 2006*). This document was developed by the Trust in consultation with the NPS, the DTSC, RWQCB, United States Environmental Protection Agency (USEPA), and community members of the RAB. For petroleum-related constituents, the SCRs for soil are proposed as Presidio-wide cleanup levels. For non-petroleum-related constituents, the cleanup levels were derived in the Cleanup Level Document and proposed as Presidio-wide cleanup levels.

The Cleanup Level Document identifies several steps to select appropriate site-specific cleanup levels (*EKI, 2002; Table 7-6 Revised May, 2006*). This includes identification of the following: impacted media, predominant soil lithologies, planned human land use, planned ecological land use, whether petroleum-related chemicals are present, and resources to be protected. The most stringent cleanup level

is then selected as the appropriate cleanup level. Accordingly, the appropriate cleanup levels are media, location, chemical, and depth-specific.

3.2.1 Applicable Soil Cleanup Levels

For soil the most conservative cleanup levels were selected based on potential endpoints (e.g., protection of human health, ecological receptors [non special-status species], and water quality). The following applicable cleanup levels for soil were used in selecting cleanup levels:

- Protection of Human Health, Residential Use - Planned land use at the Building 1065 Area is a mixture of residential and commercial/recreational land uses (*EKI, 2002; Table 7-6 Revised May, 2006*). Because the Trust has a preference for permanent “clean closure” remedies without the need for Land Use Controls whenever, practical, cost-effective, and consistent with future land use, the more stringent residential cleanup levels were selected as cleanup levels for protection of human health.
- Protection of Ecological Receptors, Buffer Zone - The western and northwestern portion of the site has been identified as an ecological buffer zone in Figure 7-2 of the Cleanup Level Document (*EKI, 2002; Table 7-6 Revised May, 2006*). Accordingly, buffer zone cleanup levels were considered when selecting cleanup levels for the western portion of the site.
- Protection of Freshwater Ecological Receptors - The FEPZ established under RWQCB Order SCR 96-070 (*RWQCB, 1996*) and maintained in the later the RWQCB Order (*RWQCB, 2003*) intersects the western portion of the site. Reuse plans for the zone include restoration of the Tennessee Hollow drainage corridor west of the site including a freshwater stream that will traverse this zone and discharge into the tidal wetlands of Crissy Field. The POCCs are cleanup levels for protection of freshwater ecological receptors and are applicable in the portion of the site that falls within the FEPZ (*BBL, 2004*).
- Protection of Groundwater at Drinking Water Levels - According to the *RWQCB (2004)*, groundwater at the Building 1065 CAP Area could be used as a potable water supply because it is located within the Northeastern Section of the Marina Groundwater Basin. Therefore, groundwater protection values petroleum-related constituents in soil were selected to protect groundwater quality based on maintaining drinking water supplies. Depending on the location of the sample at the site and the depth of the sample, two different cleanup levels protective of groundwater are applicable. More stringent levels are applicable to contaminated soil within 5 feet of groundwater.
- Metals Background Concentrations for Beach/Dune Sand - Background threshold metals concentrations for Beach/Dune Sand were used to assess metals concentrations (*EKI, 2002; Table 7-6 Revised May, 2006*).
- There are several chemicals that have been detected in soil at the site for which Presidio-specific cleanup levels have not been developed. For these chemicals, environmental screening levels (ESLs) developed by the *RWQCB (2005)*, were selected as cleanup levels for this investigation, in accordance with the Cleanup Level Document (*EKI, 2002; Table 7-6 Revised May, 2006*). The ESLs incorporate the following endpoints of concern: human health, ecological protection, groundwater quality, and surface water quality.
- The chemical 2-hexanone does not have an established cleanup level or an ESL. Based upon physical properties and the limited toxicity data, 2-hexanone appears to be similar to MIBK

with respect to both physical properties and toxicity. Therefore, the ESL for MIBK is used as a surrogate for 2-hexanone (Appendix E).

Freshwater Ecological Protection Zone and Buffer Zone Area

The soil cleanup levels that were selected for the portion of the site that falls within the FEPZ and ecological buffer zone were the most stringent of the following:

- Protection of Human Health, Residential Use;
- Protection of Ecological Receptors, Buffer Zone;
- Protection of Freshwater Ecological Receptors; and
- Protection of Groundwater at Drinking Water Levels.

In the case of metals, if the background threshold value was higher than the most stringent cleanup level for a given metal, then the background threshold value was used as the cleanup level for that metal.

Outside of Freshwater Ecological Protection Zone and Buffer Zone Area

The soil cleanup levels that were selected for the portion of the site that lies outside of the FEPZ and ecological buffer zone were the most stringent of the following:

- Protection of Human Health, Residential Use;
- Protection of Groundwater at Drinking Water Levels; and
- ESLs (for chemicals for which no Presidio-specific cleanup levels have been developed).

In the case of metals, if the background threshold value was higher than the most stringent cleanup level for a given metal, then the background threshold value was used as the cleanup level for that metal.

Table 5 presents selected cleanup levels for soil at the Building 1065 Area.

3.2.2 Applicable Groundwater Cleanup Levels

For groundwater, the following applicable cleanup levels were used in selecting cleanup levels:

- Protection of Human Health, Drinking Water Levels – The Building 1065 Area is located within the Northeastern Groundwater Area of the Marina Groundwater Basin. The groundwater is a possible source for municipal water supply and surface water replenishment (RWQCB, 2003).
- Protection of Freshwater Ecological Receptors – As discussed above, the FEPZ established under the RWQCB Order (Plates 2 and 3; RWQCB, 2003) intersects the northwest portion of the Site.
- For chemicals for which Presidio-wide cleanup levels have not been established, maximum contamination limits (MCLs) or RWQCB ESLs were used as cleanup levels.

The cleanup levels that were selected for the portion of the site that falls within the FEPZ and ecological buffer zone were the most stringent of the following:

- Protection of Human Health, Drinking Water Levels (MCLs);
- ESLs (if there are no MCLs for a given chemical);
- Protection of Freshwater Ecological Receptors.

The cleanup levels that were selected for the portion of the site that lies outside of the FEPZ and ecological buffer zone were the most stringent of the following:

- Protection of Human Health, Drinking Water Levels (MCLs); and
- ESLs (if there are no MCLs for a given chemical).

Table 6 presents selected cleanup levels for ground water.

3.3 Chemicals of Concern

Concentrations of detected chemicals were compared to applicable cleanup levels to identify chemicals that were present at the site at levels that could potentially pose risk to human health and the environment. Chemicals exceeding cleanup levels were identified as COCs because they were present at levels that could potentially pose risks to human health or the environment. The following describes the COCs identified in soil and groundwater at the site.

3.3.1 Chemicals of Concern in Soil

The chemicals that exceed cleanup levels in soil include:

- Petroleum hydrocarbons - TPHfo, TPHg, and TPHd;
- VOCs - benzene, ethylbenzene, 2-hexanone, and toluene;
- PAHs – benzo(a)pyrene; and
- Metals – arsenic, cadmium, lead, and zinc.

The depth, concentrations, and locations of the exceedances in soil are shown on Plate 12.

Petroleum hydrocarbons, benzene, ethylbenzene, and toluene are likely present in soil from past surface spills from vehicle maintenance or storage activities, releases from former FDS lines, ASTs, USTs, and also may be contaminants in debris fill material. Accordingly, benzene, ethylbenzene, toluene, TPHfo, TPHg, and TPHd have been retained as COCs.

Because PAHs are a component of petroleum hydrocarbon fuels, and therefore may be present as a result of releases of petroleum hydrocarbons, benzo(a)pyrene has been retained as a COC. It should be noted that PAHs such as benzo(a)pyrene could also be derived from other sources such as asphalt fragments that may be present in the debris fill at the site.

There are a number of likely sources of metals in soil that include fuels, waste oil, paints, particulates from burning, non-native fill, and anthropogenic debris. Because the metals exceedances are generally

co-located or are in the vicinity of petroleum hydrocarbons exceeding cleanup levels, arsenic, cadmium, lead, and zinc have been retained as COCs for this CAP.

3.3.2 Chemicals of Concern in Groundwater

The chemicals that exceed cleanup levels in groundwater include:

- TPHg;
- Benzene;
- Arsenic; and
- Antimony.

The locations and concentrations of the chemicals exceeding cleanup levels in groundwater are shown on Plate 13.

TPHg and benzene were retained as COCs because they were detected above cleanup levels and appear to be present in groundwater from past releases from the gasoline and diesel USTs formerly located at the site.

As discussed in Section 2.5.3, Arsenic is not believed to be present from a release of metals from past use of the site for storage and distribution of petroleum fuels or for maintenance of vehicles, but ~~due to rather because reducing conditions present in saturated soils where petroleum releases occurred and caused arsenic present in iron coatings on soil to mobilize into groundwater.~~ of a combination of (1) locally reducing conditions in groundwater caused by degradation of organic matter in the underlying Bay Mud and/or degradation of petroleum hydrocarbons from a past release of petroleum fuels at the site, and (2) a source of arsenic in the native sand or fill material overlying the Bay Mud. It should also be noted that degradation of petroleum hydrocarbons in the vicinity of the former USTs also may have contributed to reducing conditions and locally increased arsenic solubility in groundwater.

Antimony was detected above cleanup levels, but was not retained as a COC because the detection of antimony in HydroPunch samples collected in the vicinity of Building 1063 ~~needs to be~~ was not confirmed by samples collected from monitoring wells. First Quarter 2005 groundwater monitoring samples were analyzed for antimony to assess whether antimony is actually present above cleanup levels in groundwater at the site. Results of the First Quarter 2005 sampling show that antimony was not detected in wells at concentrations exceeding cleanup levels (T&R, 2005b). ~~will be evaluated in the CAP Work Plan.~~

3.4 Identification of Remedial Units

This section describes the areas where COCs were detected at concentrations that exceed cleanup levels. Based on the occurrence of COCs exceeding cleanup levels, three soil RUs and one groundwater RU have been identified (Plates 14 and 15). Potential cleanup technologies will be identified, evaluated, and selected to cleanup each of these RUs in Sections 4.0 and 5.0 of this CAP.

3.4.1 Soil Remedial Units

Soil Remedial Unit A – Soil Remedial Unit A (RU-A) is located beneath, north, south of Building 1063 and comprises approximately 1,100 ~~070~~ cy of soil (Plate 14). At RU-A, the COCs, benzo(a)pyrene, TPHd, TPHf, TPHg, 2-hexanone, benzene, ethylbenzene, toluene, lead, cadmium, and arsenic, were

detected above cleanup levels in vadose and saturated zone soil between 2.5 and 8.5 feet bgs. Contamination is not expected to extend below 8 to 8.5 feet bgs, the estimated top of the Bay Mud aquitard in this area.

Building 1063, constructed in 1941, is considered to be a historic structure of contributive value to the NHL and therefore, has been designated to be preserved. The Trust plans to reuse and rehabilitate the building to house a recycled water treatment plant. The building comprises a concrete slab floor, axial gable roof, roof support columns on 12-foot spacings, and walls composed of corrugated iron. At locations in Building 1063 where heavy equipment and storage tanks will be installed, the Trust plans to remove roof support columns, remove the roof, remove a portion of the south building wall, saw cut and remove the concrete floor slab, excavate soil, and install a water storage tank that will be partially below grade. These building demolition activities have been approved by the Trust N² group, a team of Trust Resource Specialists that review prospective projects to make sure that project activities are performed in accordance with the NEPA, Section 106 of the NHPA, and the Presidio Programmatic Agreement for Area B. These planned demolition activities will provide access to contaminated soil that currently underlies Building 1063's concrete slab floor.

Soil Remedial Unit B – Soil Remedial Unit B (RU-B) is located in an area of debris fill in the northwestern portion of the site. At RU-B the COCs, TPHd, TPHfo, benzene, benzo(a)pyrene, cadmium, lead, and zinc were detected in unsaturated and saturated zone soils between 2 and 7.3 feet bgs at concentrations exceeding cleanup levels. Contamination is not expected to extend below 8 to 9 feet bgs, the estimated depth of Bay Mud in this area. The area of impacted soil has been estimated as including all soil sampling locations and areas between where COCs were detected above cleanup levels. The estimated volume of impacted soil is approximately 9,200 cy (Plate 14). The area underlies a paved parking lot with landscaped traffic islands and in an area that lies within the FEPZ. The areal extent of COCs in shallow soil in this remedial unit have not been fully delineated. Additional sampling is planned in the vicinity of this area as part of the upcoming remedial investigation of Fill Site 6B.

Soil Remedial Unit C – Soil Remedial Unit C (RU-C) is located partially beneath the west wall of Building 1040, adjacent to a former fuel oil AST. At RU-C, the COCs, TPHfo and TPHd are present above cleanup levels in saturated soil at 7.7 feet bgs. The estimated volume of impacted soil is approximately 90 cy.

Building 1040 was constructed in 1920 and formerly operated as a power house/steam plant. The building is one story and is constructed of unreinforced brick masonry. The floors are concrete slab on grade. During a 2002 field investigation, the concrete floor in the eastern part of the building was shown to be over 4 feet thick and very difficult to penetrate. This steam plant is one of the few remaining structures of the original Letterman Hospital Complex. The building is a historic structure and is of contributive value to the NHL and therefore, has been designated to be preserved.

3.4.2 Groundwater Remedial Unit

Groundwater Remedial Unit A – Groundwater Remedial Unit A comprises shallow groundwater (6 to 12 feet bgs) beneath and adjacent to the south wall of Building 1063 containing TPHg and benzene above cleanup levels. This unit is in the same general location as Soil RU-A and is believed to be associated with contaminated soil found at that location. The plume does not appear to extend as far south-north of this area as Soil RU-A because samples collected from Piezometer 1065PZ1A as part of the quarterly groundwater monitoring program has not shown TPHg and benzene at concentrations exceeding cleanup levels.

As discussed in Section 2.5.2.2 and 2.5.3, elevated dissolved arsenic concentrations in groundwater at the site are likely the result of geochemical changes caused by locally reducing conditions from ~~degradation of organic matter in the Bay Mud underlying the site and/or~~ degradation of petroleum hydrocarbons in the shallow groundwater zone, and to a lesser extent from degradation of organic matter in the Bay Mud underlying the site. Consequently, no formal arsenic groundwater RU has been established and groundwater monitoring for arsenic has been incorporated into the alternative for RU-A.

4.0 SUMMARY AND EVALUATION OF ALTERNATIVES

This Section presents the summary and evaluation of corrective action alternatives for the soil and groundwater RUs A and C described in Section 3.4 and shown on Plates 14 and 15 within the Building 1065 CAP Area. Because the areal extent of COCs in soil at RU-B have not been fully delineated, a final corrective action cannot be selected for RU-B in this CAP. Additional delineation sampling is planned at RU-B as part of the upcoming remedial investigation of Fill Site 6B. Evaluation and selection of a remedial alternative for RU-B will be documented in the Presidio Trust's RAP covering Fill Site 6B. RAP. From this point on, only RU-A and RU-C will be evaluated by this CAP.

This section is organized as follows:

- Section 4.1: Identification and Screening of Potential Remedial Technologies — Identifies and screens potential remedial technologies for each of the soil and groundwater RUs based on the three initial evaluation criteria of effectiveness, implementability, and relative cost. Potential remedial technologies were not screened for RU-B in this CAP, but will be evaluated as part of the Fill Site 6B RAP addressing Fill Site 6B.
- Section 4.2: Corrective Action Alternatives Considered — Describes the corrective action alternatives developed for each RU assembled from the range of remedial technologies retained in the initial screening.
- Section 4.3: Criteria for the Evaluation of Corrective Action Alternatives — Describes the criteria used to evaluate each alternative in terms of its ability to meet the evaluation criteria of effectiveness, implementability, and cost, and achieve the RAOs described in Section 3.1.
- Section 4.4: Evaluation of Corrective Action Alternatives — Evaluates and compares the corrective action alternatives considered for each RU based on their ability to achieve the RAOs and the evaluation criteria as summarized in Table 7.
- Section 4.5: Recommended Corrective Action Alternatives — Presents the rationale for selection of a recommended corrective action alternative for each RU based on the evaluation and comparison of alternatives as summarized in Table 8.

4.1 Identification and Screening of Potential Remedial Technologies

This section identifies and screens the potential soil and groundwater remedial technologies that could be applied as part of corrective actions to address the contaminants in ~~the~~ RUs A and C identified in Section 3.4 and shown on Plates 14 and 15.

The three initial evaluation criteria of effectiveness, implementability, and relative cost are applied to initially screen potential remedial technologies identified for the ~~two~~^{three} soil RUs and one groundwater RU identified for the Building 1065 CAP Area as follows:

Effectiveness

Effectiveness refers to the ability of a technology to address: 1) the estimated area or volumes of media requiring remediation to meet the RAOs; 2) the potential impacts to human health and the environment during implementation; and 3) the long-term reliability and proven history of the technology with respect to remediating the types of chemicals and site conditions within each RU.

Implementability

Implementability refers to both the technical and administrative feasibility of implementing a particular remedial technology, including: 1) the likelihood of obtaining permits and approvals from regulatory agencies; 2) the availability of appropriate treatment, storage, and disposal facilities; and 3) the availability of the equipment, materials, skilled workers, and other resources.

Relative Cost

Relative cost includes the anticipated order-of-magnitude capital and operation and maintenance (O&M) costs associated with implementing a particular remedial technology. This criterion evaluates whether the capital and operating costs of implementing the technology are low, moderate, or high as compared to other applicable technologies. Relative costs are estimated based on experience on similar projects; engineering judgment; and remediation technology databases. Required expenditures are compared against the potential benefits of each technology, and can be used to eliminate options that are substantially more expensive than other technologies that provide the same level of protection.

The potential remedial technologies that are considered in the screening include:

- No action
- Land use controls
- Capping
- In situ soil and groundwater treatment
- Extraction and ex situ groundwater treatment
- Excavation of soil with ex situ soil treatment
- Excavation of soil with offsite disposal.

The remedial technology screening focuses on petroleum-related organic compounds present within the RUs (e.g., TPH and VOCs) that are the primary COCs in terms of their distribution and frequency of detection, and does not specifically consider treatment of inorganic contaminants (i.e., the metals arsenic, lead, cadmium, and zinc) for the following reasons:

- Metals in Soil: As described in Sections 2.5.1 and 3.3.1, there are isolated occurrences of metals in soil above cleanup levels (RUs A and B). With the exception of arsenic, metals in soil do not appear to have impacted groundwater and their distribution and frequency of detection is limited. There are no readily available, proven, and implementable remedial technologies for treating isolated occurrences of metals in soil. In addition, metals in soil are unlike organic compounds which can vaporize and migrate to the surface and present potential exposures, and the majority of the surface area of these RUs are covered by existing pavement or buildings which effectively eliminate the exposure pathways to subsurface metals. Therefore, remedial technologies specific to metals in soil are not evaluated further, and it is assumed the corrective action alternatives that may be implemented to address petroleum-related COCs in soil would address isolated occurrences of metals in soil as well (e.g., capping, excavation).

- Metals in Groundwater:** As described in Sections 2.5.2 and 3.3.2, arsenic and other metals were detected in groundwater above cleanup levels at isolated locations. ~~Review of the arsenic data suggest that it is correlated with reducing conditions that are influenced by a combination of the organic material in the underlying bay mud and/or the degradation of petroleum hydrocarbons and a source of arsenic in saturated materials.~~ As discussed in Section 2.5.3, elevated dissolved arsenic concentrations in groundwater at the site are likely the result of geochemical changes caused by locally reducing conditions from degradation of petroleum hydrocarbons in the shallow groundwater zone, and to a lesser extent from degradation of organic matter in the Bay Mud underlying the site. Therefore, arsenic will be retained as a COC for groundwater and concentration trends will be monitored under each of the corrective action alternatives that may be implemented. These corrective actions are planned to address petroleum-related COCs in soil and groundwater (e.g., by, capping or excavation in conjunction with continued groundwater monitoring (to assess the effectiveness of the corrective action alternative implemented in reducing COCs below cleanup levels)). ~~for purposes of further evaluation consistent with the adjacent Commissary PX Site CAP (T&R, 2004a).~~ Remedial technologies specific to arsenic in groundwater are not evaluated further at this time.

The potential remedial technologies for soil and groundwater contaminated with petroleum-related organic compounds are described and screened below based on their effectiveness, implementability, and relative cost. These discussions indicate whether each technology is either retained for further consideration or eliminated from further consideration as components of the potential corrective action alternatives described in Section 4.2.

4.1.1 No Action

The “no action” technology assumes no corrective actions of any kind would be implemented to address the presence of contaminants in soil or groundwater, and is included in the evaluation as a baseline for comparison to other alternatives.

No Action is retained for further consideration for both soil and groundwater RUs as a corrective action alternative.

4.1.2 Land Use Controls

Land use controls (LUCs) refer to administrative restrictions on the potential future use of land based on the levels of contaminants that may be left onsite at concentrations greater than allow for unrestricted use. The Trust generally does not consider LUCs by themselves to meet the cleanup goals for sites where contaminated materials remain left in-place and potentially exposed. LUCs restrict future site use and future site activities in order to limit exposure to COCs left in place or to ensure the effectiveness of the selected site remedy. The Building 1065 Area RUs are located in Area B of the Presidio. Existing and planned land uses in Area B are directed by the Trust through its comprehensive land use and management plan, the Presidio Trust Management Plan (PTMP) (Trust, 2002). LUCs in Area B are managed in accordance with the Presidio Trust’s Land Use Control Master Reference Report (LUCMRR).

The LUCMRR serves as the Trust’s overall implementation and enforcement plan to meet the requirements of State of California requirements and §5.11 of the Consent Agreement (DTSC, 1999). The LUCMRR provides the framework to LUC management in Area B and describes the procedures the Trust will use to track, implement and enforce LUCs at remediation sites in Area B where LUCs are part of the selected remedy. For each individual site identified as requiring a LUC, a site-specific addendum to the LUCMRR will be prepared. Each site-specific LUCMRR addendum will include a figure depicting

the site location and nearby area, and will summarize the site history, the specific COCs encountered at the site, the actions taken to remediate the site, the in-place management system (such as containment), the levels and general locations of COCs remaining at the site that required the implementation of the LUC, and site-specific restrictions for that LUC area. In addition, these site-specific addenda will discuss restricted or prohibited land uses at the site and any special requirements (e.g., health and safety requirements) if the area is disturbed in the future. The site-specific LUCMRR addenda will be added to the Trust's GIS system that serves as an informational database for all remediation sites with LUCs in Area B of the Presidio. The LUCMRR identifies the content requirements of site-specific addenda.

As a federal agency, the Trust is required under NEPA to consider the potential environmental impacts of any project, plan, program, or action at the earliest stage of planning and before implementation. The Trust carries out this obligation using a project review process that screens proposals for compliance with NEPA/NHPA ("N²"), and other such laws and regulations. The Trust's N² compliance process screens every proposed action in Area B at the Presidio (e.g., fence post installation, tree trimming, native plant restoration, building renovation, and building demolition). The N² compliance process (i.e., project review program) is a first step to insure that Trust staff is aware of known contamination and associated LUCs in the vicinity of project sites. This review process, by scrutinizing the attributes of the project site and the proposed action, can be used to alert Trust staff to known and remediated hazardous substance sites, as well as LUCs.

In addition, for any Area B project involving construction, excavation, or subsurface work, the Trust requires not only N² clearance but also a building/project permit. For any project, the permit process requires Preliminary Design, Preliminary Plan Review, Design Development, and Permit Plan Review and approval. Here too, at the earliest stage of project planning, the Trust project manager, tenant, or user is provided with an information checklist with key information about the project site, including any LUCs. The Trust will use its project permit process to notify and require adherence by project proponents to any LUC restrictions and requirements. Both the Trust's project review and project permitting programs will include a link (i.e., in both the standardized N² project screening form and the project permit checklist) to the Trust's GIS system containing complete LUC site information.

In general, LUCs in Area B of the Presidio are intended to fulfill the following goals:

- Maintain protection of human health and the environment over time;
- Prevent inappropriate land use of the property containing residual contamination in soil or groundwater;
- Assure that information about the property containing residual contamination in soil or groundwater is available to the local government or the public;
- Ensure that long-term mitigation measures and monitoring requirements are carried out and maintained;
- Ensure that the integrity and stability of the remedy (implemented corrective action alternative) is maintained;
- Ensure that subsequent property owners or transferees have a duty to assume any responsibility for requirements or restrictions pertaining to the residual contamination in soil or groundwater when the property is transferred; and
- Ensure that appropriate regulatory agencies will be contacted prior to a change in land use or change to the selected remedy.

If LUCs are implemented at the Building 1065 Area, the Trust will undertake the procedures below to ensure that the appropriate LUCs are adhered to by present and future owners and users of the Site:

- **Prepare a Site-Specific Addendum to LUCMRR** – This site-specific addenda to the Trust’s LUCMRR will be specific to those portions of the Building 1065 Area where LUCs are incorporated into the selected remedy. Each site-specific LUCMRR addendum will include a figure depicting the site location and nearby area, and will summarize the site history, the specific COCs encountered at the site, the actions taken to remediate the site, the in-place management system (such as containment), the levels and general locations of COCs remaining at the site that required the implementation of the LUC, and site-specific restrictions for that LUC area. In addition, these site-specific addenda will discuss restricted or prohibited land uses at the site and any special requirements (e.g., health and safety requirements) if the area is disturbed in the future. The Site-Specific Addendum of the LUCMRR for the Building 1065 Area will be submitted with the Construction Completion Report for this Site.
- **Project Permit Process** – In advance of implementation, all Presidio plans and projects in the vicinity of the Building 1065 Area will be screened by the N² process and Excavation Clearance Permit (“dig permit”) process. Planning/project proponents will be notified of the LUCs specific to the Blg 1065 Area. The Trust will require adherence to the restrictions and requirements set forth in the Site-Specific Addendum to the LUCMRR for the Building 1065 Area.
- **LUC Tracking in the Trust’s GIS Database** – The Trust will include LUC area(s) for the Building 1065 Area in the GIS database that the Trust is preparing to monitor its LUC sites. This database will be available to Trust staff to facilitate decision making and land use planning for Presidio sites.
- **Notification and Annual Monitoring** – The Trust will prepare an annual Presidio LUC Report to confirm that land uses within Presidio are consistent with the restrictions and requirements of all LUC areas in Area B of the Presidio. The Trust will provide DTSC and RWQCB with a copy of this annual report. In addition, the Trust will notify DTSC and RWQCB of any proposed action that may disrupt the effectiveness of the LUCs, and any proposed action that could alter or eliminate the continued need for LUCs.
- **Transfer of Ownership or Control** – The Trust will notify DTSC and RWQCB of any anticipated transfer of ownership or control of any portion of a LUC area in Area B of the Presidio. In the event of a transfer of ownership or control of the LUC area, in whole or in part, the Trust will record the Presidio’s LUCMRR with the City and County of San Francisco Recorder’s Office and the Federal General Services Agency (GSA) to place subsequent Presidio owners or managers on notice of the existence of the LUC area. As part of the administrative transfer of the Site, the Trust will notify the subsequent owner or manager of the duty to comply with the LUC and provide a current copy of the LUCMRR.

LUCs are anticipated to be effective and implementable for soil and groundwater RUs within the Building 1065 Area, specifically for RUs that are less accessible and/or have low-level residual contamination. The relative cost of implementing and LUC is low.

LUCs refer to administrative restrictions on the potential future use of land based on the levels of contaminants that may be left on-site either (1) in lieu of other corrective actions; (2) in combination with other corrective actions; or (3) after other corrective actions have been implemented. LUCs would restrict future site disturbance or maintain site cover in order to minimize environmental exposure to any remaining site risks due to potential exposure to COCs. The Building 1065 CAP Area RUs are located in Area B of the Presidio. Existing and planned land uses in Area B are directed by the Trust through its

comprehensive land use and management plan, the PTMP (*Trust, 2002*). LUCs for Area B remediation sites include restricting or controlling site uses by administrative procedures such as preparing a site-specific addendum to the Presidio Trust's Land Use Control Master Reference Report (LUCMRR). Trust planning/project proponents and members of the public may review all existing LUCs for the Presidio by reviewing the LUCMRR in the Trust Library. The Trust would notify DTSC and RWQCB of any proposed action that may disrupt the effectiveness of the LUCs, and any proposed action that could alter or eliminate the continued need for LUCs.

The Trust generally does not consider LUCs by themselves to meet RAOs for sites where contaminated materials remain left in place and where there are potential exposure pathways to human or ecological receptors. LUCs may be used in combination with certain engineering controls (e.g., capping) that create a physical barrier between the contaminated material and human or ecological receptors. LUCs are used to protect the engineering controls by preventing soil disturbance and exposure.

LUCs are intended to fulfill the following goals:

- Prevent inappropriate land use of the property containing residual contamination in soil;
- Assure that information about the property containing residual contamination in soil is available to the local government or the public;
- Ensure that long term mitigation measures and monitoring requirements are carried out and maintained;
- Ensure that the integrity and stability of the remedy is maintained;
- Ensure that subsequent property owners or transferees have a duty to assume any responsibility for requirements or restrictions pertaining to the residual contamination in soil when the property is transferred; and
- Ensure that appropriate regulatory agencies will be contacted prior to a change in land use or the selected remedy.

The following provides some examples of typical LUC restrictions and requirements:

- **Allowable Land Uses**—The allowable land uses may be restricted. For example, residential uses may not be allowed.
- **Administrative Controls**—For a project that involves excavation or intrusion into the subsurface within the LUC area, a project permit, including excavation clearance and project conditions and mitigations, will be applied for and approved by the Trust prior to commencement of surface disturbance.

Management of Excavated Soils/Materials—All soils excavated within the LUC area must be managed and/or disposed in accordance with then applicable federal, state and local laws governing excavation, handling, management, and disposal of the excavated material.

- **Imported Fill**—Imported fill must meet the cleanup levels for the applicable land use.
- **Management of Surface Water/Groundwater**—All waters impacted with COCs above cleanup levels within the LUC area must be managed and/or disposed in accordance with then applicable federal, state and local laws governing monitoring, management, and disposal.

If LUCs are implemented at the Building 1065 CAP Area, the procedures below will be followed to ensure that the specified LUCs are adhered to by present and future owners and users of the site:

Project Permit Process—In advance of implementation, all Presidio plans and projects must be screened for compliance with the NEPA and the NHPA. The Trust, as applicable, will use its interdisciplinary NEPA/NHPA environmental screening process to notify planning/project proponents of the LUC and require adherence to the restrictions and requirements set forth for any plan/project involving the LUC area. In addition, for any project involving excavation or subsurface intrusion within the LUC area, the Trust must approve a “dig permit” to ensure that subsurface utilities (water, gas, sewer, fiber optic) are not damaged. The Trust will also use its Excavation Clearance Permit process to notify and require adherence by excavation project proponents of the LUC restrictions and requirements.

LUCs Master Reference Report—The LUC area will be included in the Trust’s LUC Master Reference Report. The LUCMRRs, which includes a master map showing all Presidio-wide LUCs Zones and a compilation of all Presidio LUCs requirements and restrictions, is maintained and kept current at the Trust Library. Planning/project proponents and other members of the public may review all existing LUCs for the Presidio by reviewing the LUCMRRs in the Trust Library. The LUCMRRs will also be posted on a Trust website in the future.

Notification and Annual Monitoring—The Trust will notify DTSC and RWQCB regarding a proposed land use plan or project that may be inconsistent with the LUC, any proposed action that may disrupt the effectiveness of the LUC, and any proposed action that could alter or eliminate the continued need for the LUC. The Trust submits an annual Presidio LUCs Report to confirm that human land uses within Presidio LUCs Zones are consistent with the restrictions and requirements specified.

Transfer of Ownership or Control—The Trust will notify DTSC and RWQCB of any anticipated transfer of ownership or control of any portion of the LUC area. In the event of a transfer of ownership or control of the LUC area, in whole or in part, the Trust will record the Presidio’s LUCMRRs with the City and County of San Francisco Recorder’s Office to place subsequent Presidio owners or managers on notice of the existence of the LUC area. As part of the administrative transfer of the site, the Trust will notify the subsequent owner or manager of the duty to comply with the LUC and provide a complete copy of the LUCs Master Reference Report.

LUCs are anticipated to be effective and implementable for soil and groundwater RUs within the Building 1065 CAP Area, specifically for RUs that are less accessible and/or have low-level residual contamination. The relative cost of this technology is low.

LUCs are retained for further consideration for both soil and groundwater RUs in combination with other remedial technologies.

4.1.3 Capping

Capping involves either placing a synthetic surface layer (geotextile) or enhancing an existing surface cover (soil, asphalt, or concrete) over a contaminated area as a barrier to (1) isolate and prevent exposure to human and/or ecological receptors to contaminants in the soil; and (2) minimize surface water infiltration that could potentially promote migration of contaminant sources in soil into groundwater. A cap would require long-term inspection and maintenance, and intrusive activities would be restricted by specific LUCs. Groundwater monitoring would be included in any alternative using this technology to monitor for potential future impacts caused by remaining contamination.

Capping is anticipated to be effective and implementable for soil and groundwater RUs within the Building 1065 CAP Area, specifically for RUs that are less accessible and/or have low-level residual contamination. The relative cost of this technology is low, especially where an existing barrier (e.g., a paved surface) can simply be improved upon (e.g., resealed, patched), if necessary.

Capping is retained for further consideration for both soil and groundwater RUs in combination with other remedial technologies.

4.1.4 In Situ Soil and Groundwater Treatment

Treatment technologies involve the reduction of the toxicity, mobility, or mass of COCs present in soil or groundwater. In situ soil and groundwater treatment technologies involve treatment in place in the subsurface without excavation or groundwater extraction, and for the COCs present within the Building 1065 CAP Area RUs potentially include:

- Bioremediation technologies: biosparging, bioventing, and enhanced bioremediation with an oxygen release product;
- Sparging and extraction technologies: air sparging, ozone sparging, and soil vapor extraction; and
- Chemical oxidation technologies: hydrogen peroxide and sodium persulfate.

These treatment technologies could be implemented as stand-alone technologies for soil contamination only (single-phase), or could be implemented to treat both soil and groundwater (dual-phase) in areas where these RUs overlap or are collocated (RUs A).

Application of an oxygen release product (e.g., ORC[®] or equivalent technology) is the only in situ treatment option retained for further consideration for collocated soil and groundwater contamination (RUs A) based on (1) an evaluation of the site-specific effectiveness of the various in situ treatment technologies for the COCs present in the soil and groundwater RUs within the Building 1065 CAP Area, (2) results of the Phase II Interim Action Work Plan for Building 1063 that selected oxygen release product as the most effective and preferred technology for these RUs (MACTEC, 2004a), and (3) consideration of the implementability and relative cost of the various options. For TPHg and VOCs in Soil and Groundwater RUs A, other bioremediation and sparging and extraction technologies would not be as effective as oxygen release products, and chemical oxidation can impact saturated zone geochemistry and increase the solubility of metals in the subsurface. However, RUs A are located beneath an existing historic structure (Building 1063) where renovations are planned underway to convert the building into a recycled water storage tank treatment facility that includes installation of below-grade tank(s) within the building. In order to install the water storage tank partially below grade within this building, the Trust plans to remove roof support columns, remove the roof, remove a portion of the south building wall, saw cut and remove the concrete floor slab, excavate soil, and install a water storage tank, while maintaining the building walls. Prior to or in coordination with the water treatment plant project construction planned within the building ~~Once the support columns, roof, and floor slab have been removed~~, contaminated soil in this RU will be excavated, ~~from within the building footprint, with a portion of the soil contamination left beneath inaccessible building walls and footings. The building will then be restored and reused as a water storage tank facility.~~ Therefore, this technology would only be initially considered via application of oxygen release product within the excavation floor as part of the excavation technology described below. After the renovation work is completed, if groundwater monitoring data indicates the excavation of source materials and application of oxygen release product within the excavation did not reduce groundwater COCs below cleanup levels, additional application of this technology would be reconsidered as a contingency via in situ injection as described in the Phase II Interim Action Work Plan for Building 1063 (MACTEC, 2004a).

The primary COCs at For Soil RUs B and C are; the heavier-end TPH compounds such as TPHd and TPHf. Because these are heavy-end petroleum hydrocarbons (which are the primary COCs within these

~~RUs) mainly occur in unsaturated soils, they and~~ can not be effectively treated using ~~the above~~ technologies that rely on volatilization (sparging, venting, vapor extraction). Therefore, those technologies were not retained for further consideration for Soil RU C.

In situ treatment using an oxygen release product is retained for further consideration for collocated Soil and Groundwater RUs A in combination with other remedial technologies.

4.1.5 Extraction and Ex Situ Groundwater Treatment

This technology would be difficult to implement within the shallow aquifer within groundwater RU-A because it would have significant impacts on the ongoing and planned recycled water ~~tank-treatment plant~~ construction and operations within the Building 1063 Area due to installation and operation of equipment that would remain in place and require monitoring and maintenance as well as reuse/reinjection of treated groundwater within this area. In addition, its effectiveness in extracting and treating low concentrations of COCs in groundwater for the subsurface conditions in this area (i.e., a shallow, low-flow groundwater table) may be limited, with a relatively high associated cost.

Extraction and ex situ groundwater treatment is eliminated from further consideration.

4.1.6 Excavation and Ex Situ Soil Treatment

Ex situ soil treatment technologies treat contaminated soils after they are excavated from the subsurface, and include landfarming, ex-situ soil vapor extraction (SVE), biopiles, or low-temperature thermal desorption. Ex situ technologies have certain advantages over in situ methods, such as easier verification sampling, greater process control, and lower unit cost, and they can be implemented onsite or offsite depending on site-specific considerations. However, under current disposal market conditions in California, treating non-hazardous soils prior to offsite disposal to meet the acceptance criteria of a less expensive disposal facility, whether performed onsite or offsite, is not cost effective. Construction and operation of a high-profile ex situ soil treatment unit onsite in public areas to address limited volumes of soil is not practical or cost effective. Onsite stockpiling and treatment of petroleum-contaminated soil would also create nuisance issues such as visual impacts and odors. There are a limited number of offsite facilities that will treat petroleum-contaminated soil prior to disposal, and transportation to such facilities and treatment costs are high.

Excavation and ex situ onsite or offsite soil treatment is eliminated from further consideration.

4.1.7 Excavation and Off-Site Disposal

Excavation is a practical source removal technology that would be applicable to the conditions at the Building 1065 CAP Area. The majority of the contamination is located within the upper 8 feet of the subsurface. Conventional excavation technologies (e.g., excavators, backhoes) can remove soil contamination to a depth of approximately 15 feet bgs without shoring, which is deeper than the maximum anticipated depth of contamination at each soil RU, including any capillary fringe or 'smear zone' contamination. The smear zone is defined as a vertical horizon of petroleum-related contamination that may occur at the saturated zone/water table interface. In this area, petroleum-related COCs present in soil can be 'smeared' within several feet of the soil column due seasonal or other fluctuations in groundwater elevations, and may extend several feet into the groundwater table or to the top of the Bay Mud. The Bay Mud extends beneath the site, and varies from approximately 8 to 15 feet bgs throughout the Building 1065 CAP Area as shown on Plate 5. Based on site data, the Bay Mud is approximately coincident with the water table and serves as an aquitard and barrier to the vertical migration of

contaminants. It is expected that contamination will be confined to silty sand and clayey sand that overlies the Bay Mud.

If smear zone contamination is present, it may continue as a source of contamination to groundwater if not completely removed. Therefore, the excavations will be designed to extend below the smear zone into the top of the Bay Mud aquitard wherever technically practicable, with dewatering of the excavation. The intent will be to remove all petroleum-affected soils to below the smear zone, as well as groundwater within the excavation that may be impacted by smear zone contamination. Excavation and removal of the impacted soil with subsequent confirmation sampling and groundwater monitoring would be effective and implementable for the majority of the impacted soil (Soil RUs A and B), and would also eliminate the source of contaminants to the Groundwater RU-A to the extent practicable consistent with the proposed future land uses as follows:

~~—Soil and Groundwater RUs-A: Excavation and removal would extend to the top of the Bay Mud, and would extend laterally to encompass the majority of the Soil RUs as feasible based on constraints necessary to preserve Building 1063 which is a designated . However, the lateral extent would be limited somewhat because a large portion of the RU is located beneath an existing historic structure (Building 1063). In order to install a water storage tank(s) that will be partially below grade within this building, the Trust plans to remove roof support columns, remove the roof, remove a portion of the south building wall, saw cut and remove the concrete floor slab, excavate soil, and install a water storage tank, while maintaining the walls. Once the support columns, roof, and floor slab have been removed and, eContaminated soil in associated with this RU will be excavated from within the building footprint, with a portion of the soil contamination left beneath inaccessible building walls and footings. The building will then be restored and reused as a water storage tank facility.~~

~~—Soil RU-B: Excavation and removal would extend to the top of Bay Mud, and would extend laterally to encompass the entire Soil RU. Debris associated with the fill material is not thought to be present in sufficient volumes to make segregation and recycling of debris from soil practical from a relative cost perspective.~~

—Soil RU-C: Soil contamination extends beneath the foundation of existing Building 1040, which is an unreinforced historic brick structure with a 4-foot thick slab foundation that is designated to be preserved. Therefore, excavation of this Soil RU could not be conducted without significant impacts to the building's structural integrity, and is not considered further for this RU.

Offsite disposal of excavated petroleum-affected soils at an approved offsite disposal facility is an effective and implementable technology. Many different types of landfill disposal facilities are available in California that accepts petroleum-affected soils.

As stated above, it is anticipated that conventional excavation technologies will be able to remove the majority of petroleum-affected soils within RUs A and B, including capillary fringe or smear zone contamination that may continue to act as a source of contamination to groundwater if not completely removed (except in a portion of Soil RU-A that extends beneath the walls of Building 1063). However, if excavation technologies cannot remove all petroleum contamination in and above this zone, and for the inaccessible portion of Soil RU-A, prior to backfilling an oxygen release product (e.g., ORC[®] or equivalent technology) as described in Section 4.1.4 can be placed within the saturated zone/water table interface. The ORC[®] will treat both contaminated soil and groundwater by increasing the in situ oxygen content and enhancing the rate of aerobic biodegradation of organic contaminants such as TPH and BTEX by naturally occurring microbes. A detailed discussion of the potential application of oxygen release product in combination with excavation was presented in the Phase II Interim Action Work Plan for Building 1063 for this RU (MACTEC, 2004a). This combination of technologies would be similarly considered for application within other Building 1065 CAP Area excavations.

Excavation and offsite disposal (with in situ application of oxygen release product if necessary) is retained for further consideration for Soil and Groundwater RUs A ~~and Soil RU-B~~ in combination with other technologies.

4.2 Corrective Action Alternatives Considered

Based on the screening of potential remedial technologies for soil and groundwater at the Building 1065 CAP Area described above, the following corrective action alternatives have been assembled from the technologies retained for further consideration for evaluation and comparison for ~~the~~ RUs A and C indicated:

Remedial Unit	Alternative 1 No Action	Alternative 2 Capping, Land Use Controls, Groundwater Monitoring	Alternative 3 Excavation and Offsite Disposal of Soil, Application of In Situ Oxygen Release Product As Necessary, Groundwater Monitoring
Soil and Groundwater Remedial Unit <u>Units A (RUs A)</u> <i>Beneath Historic Building 1063 Water Tank Storage Facility</i>	X	X	X
Soil Remedial Unit <u>B (RU-B)</u> <i>Debris Fill Under Parking Area^(a)</i>	-- ^(a) X	-- ^(a) X ^(a)	-- ^(a) X ^(a)
Soil Remedial Unit <u>C (RU-C)</u> <i>Beneath Historic Building 1040</i>	X	X ^(ba)	--

^(a) Because the areal extent of COCs in shallow soil at RU-B have not been fully delineated, remedial alternatives to address contaminants at RU-B were not developed and evaluated in this CAP. RU-B will be investigated by the Trust as part of its upcoming remedial investigation of Fill Site 6B, and evaluation and selection of a remedial alternative for RU-B will be documented in the RAP which addresses Fill Site 6B.

^(ba) Groundwater monitoring is not proposed for ~~RU-B and~~ RU-C because petroleum-related groundwater COCs have not been identified at ~~those~~ this RUs.

Groundwater monitoring would also be included as a component of Alternatives 2 and 3 in order to verify RAOs are met after the alternative is implemented for a given period of time. As discussed in Section 3.4.2, a groundwater RU has not been established for detections of arsenic above cleanup levels because elevated dissolved arsenic concentrations in groundwater at the site are likely the result of geochemical changes caused by ~~a~~ locally reducing conditions from degradation of petroleum hydrocarbons in the shallow groundwater zone. Consequently, no formal arsenic groundwater RU has been established and groundwater monitoring for arsenic has been incorporated into the corrective actions alternatives evaluated for RU-A. from Bay Mud underlying the site and/or degradation of petroleum hydrocarbons in

~~the shallow groundwater zone. Consequently, groundwater monitoring for arsenic has been incorporated into the alternative for RU-A.~~

- ~~• In accordance with Task 13 of RWQCB Order R2-2003-0080, a Five-Year Status Report, which evaluates the effectiveness of this CAP for groundwater, will be completed and submitted to the RWQCB for approval. In the Five-Year Status Report, groundwater conditions at the Building 1065 Area will be evaluated and future corrective actions will be assessed. If cleanup levels for all COCs are achieved within the 5-year monitoring period, the groundwater monitoring program will be discontinued and the LUC related to groundwater contamination will be rescinded as described in further detail in Section 4.2.3.~~

The main components of these alternatives are summarized below.

4.2.1 Alternative 1—No Action

This alternative takes no action to address site contaminants and therefore has no components.

4.2.2 Alternative 2—Capping, Land Use Controls, Groundwater Monitoring

- Capping: (1) Improvements to existing surface barriers covering the RUs (e.g., structural foundations, pavement) as necessary to prevent soil disturbance and exposure to contaminants, and/or (2) Installation of new capping material over any bare-ground portions of the RUs as necessary depending on area-specific reuse, and (3) Long-term inspection and maintenance of capping materials. For RUs that extend beneath existing buildings (Soil and Groundwater RUs A and Soil RU-C), the existing building foundations and adjacent areas would be inspected and assessed to determine the need for improvements (e.g., sealing the flooring and any conduits to the subsurface, monitoring indoor air quality) to prevent occupant exposure to volatile COCs in vadose zone soils that may intrude into the building. These measures would be implemented in accordance with DTSC/Cal EPA's Interim Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air, December 15, 2004, revised February 7, 2005. ~~For Soil RU-B which extends beneath a paved parking area, the existing pavement and adjacent areas would be inspected and assessed to determine the need for improvements (e.g., patching, resealing, repaving, or installation of geomembrane and bark over landscaped areas) to prevent exposure to contaminated soils and surface water intrusion that may cause migration of contaminants in soil into the saturated zone.~~
- Land Use Controls: (1) Preparation of a site-specific addendum to the LUCMRRs for the Presidio, (2) Conducting a review of the protectiveness of the corrective action alternative every 5 years, and (3) Preparation of 5-Year Review Reports.
- Groundwater Monitoring: (1) Continued monitoring of existing wells indicated in Table 9 quarterly for the first year, and annually thereafter for petroleum-related COCs TPHg and BTEX, arsenic, and redox parameters to (a) verify COC concentrations in groundwater are not migrating offsite, and (b) assess whether concentrations of COCs in wells and piezometers at the site show trends over time (applicable to RU-A only). Groundwater samples including quality assurance/quality control (QA/QC) samples (duplicates, equipment blanks and trip blanks) will be collected, and results will be presented in the Presidio-Wide Semi-Annual Groundwater Monitoring Reports, (2) After all petroleum-related COCs and arsenic are demonstrated to be below cleanup levels for four consecutive sampling rounds, monitoring will be discontinued (with RWQCB approval) and clean closure with regards to groundwater

contamination will be documented in a site closure report, and (3) Abandonment of wells, as applicable, upon RWQCB approval. Groundwater Monitoring: (1) Continued monitoring of existing wells at RUs with petroleum-related groundwater COCs (applicable to RU-A only). These wells will be monitored for petroleum-related COCs (TPHg and BTEX) to verify that contaminant concentrations are decreasing and that contaminants in groundwater are not migrating offsite. Groundwater samples including quality assurance/quality control (QA/QC) samples (duplicates, equipment blanks and trip blanks) will be collected on an annual basis. Results will be presented in the Presidio Wide Semi-Annual Groundwater Monitoring Reports; (2) After all petroleum-related COCs are demonstrated to be below cleanup levels for four consecutive sampling rounds, monitoring will be discontinued and clean closure with regards to groundwater contamination will be documented in a site closure report, (3) Arsenic and parameters indicative of groundwater redox conditions will be monitored quarterly for one year after approval of the final CAP to assess whether concentrations in wells and piezometers at the site show trends over time. The data will also be reviewed to further evaluate the relationship between arsenic concentrations, the hydrocarbon plume, Bay Mud, or other factors that affect redox conditions and therefore, the solubility of arsenic in groundwater. This data evaluation process which will include statistical and spatial data analysis will be further described in the CAP Work Plan, which will incorporate additional groundwater data that will be collected as part of the ongoing groundwater monitoring program, (4) Abandonment of wells, as applicable, upon regulatory approval.

4.2.3 Alternative 3—Excavation and Offsite Disposal of Soil, Application of In Situ Oxygen Release Product as Necessary, Groundwater Monitoring

- Excavation and Offsite Disposal of Soil and Application of In Situ Oxygen Release Product as Necessary: (1) Removal of the Building 1063 slab foundation ~~and roof~~ to provide access to Soil and Groundwater RUs A, ~~(2) Removal of pavement and landscaped traffic islands in parking area to provide access to Soil RU-B,~~ (23) ~~Pre-remedial archaeological trenching as necessary and/or archaeological~~ Archaeological monitoring during excavation, (34) Excavation of soil containing COCs above cleanup levels to the top of Bay Mud (1,070-100 cy from Soil RU-A; ~~9,200 cy from Soil RU-B~~), stockpiling soil onsite while sampling for waste characterization purposes, (45) Dewatering as necessary within the excavations to remove as much visible/field-measurable organic COC contamination within the saturated zone as possible, (56) In situ application of oxygen release product within the excavation bottom prior to backfilling if necessary. ~~ORC will be applied if based on the technical limitations of removing visible/field-measurable not all organic COC contamination as described in the Phase II Interim Action Work Plan for Building 1063 (MACTEC, 2004a) can be removed by excavation,~~ (67) Confirmation sampling from the sidewalls and floor of the excavation with further excavation of soil if necessary until contaminants are below cleanup levels ~~or~~ to the extent practicable based on structural or other technical constraints, (78) Backfilling excavations with clean soil, grading, compacting, and preparing the area for restoration for its intended reuse, (89) Decontamination and recycling of surface structures (asphalt, pavement, concrete, etc.) to the extent practicable, (94) Loading stockpiled and characterized soil into trucks and transporting for offsite disposal at a permitted landfill facility, (101) Implementation of a LUC for groundwater that will be lifted after groundwater monitoring shows COCs below cleanup levels (See groundwater monitoring below); and potentially implementing a LUC for soil if soil containing COCs above cleanup levels cannot be removed due to structural limitations or incurring excessive costs associated with preserving the building.

- Groundwater Monitoring: (1) Continued monitoring of existing wells indicated in Table 9 quarterly for the first year for petroleum-related COCs TPHg and BTEX, arsenic and redox parameters); semi-annually thereafter for petroleum-related COCs (TPHg and BTEX); and annually thereafter for arsenic and redox parameters to (a) verify COC concentrations in groundwater are not migrating offsite, and (b) assess whether concentrations of COCs in wells and piezometers at the site show trends over time (applicable to RU-A only). Groundwater samples including quality assurance/quality control (QA/QC) samples (duplicates, equipment blanks and trip blanks) will be collected, and results will be presented in the Presidio-Wide Semi-Annual Groundwater Monitoring Reports, (2) After all petroleum-related COCs and arsenic are demonstrated to be below cleanup levels for four consecutive sampling rounds, monitoring will be discontinued (subject to RWQCB approval), and clean closure with regards to groundwater contamination will be documented in a site closure report, (3) As a contingency, additional application of oxygen release product via in situ injection for RU-A, ORC will be injected if groundwater monitoring data indicates that the excavation of source materials and the initial application of oxygen release product within the excavation did not reduce groundwater COCs below cleanup levels, and (4) Abandonment of wells, as applicable, upon RWQCB approval.

~~Groundwater Monitoring: For Groundwater RU-A only, (1) Continued monitoring of existing monitoring wells and piezometers to verify that contaminant concentrations are decreasing and that contaminants in groundwater are not migrating offsite. The wells will be monitored for petroleum-related COCs (TPHg and BTEX) to verify that contaminant concentrations are decreasing and that contaminants in groundwater are not migrating offsite. Groundwater samples including QA/QC samples (duplicates, equipment blanks and trip blanks) will be collected on a quarterly basis for one year and semi-annually thereafter. Results will be presented in Presidio-Wide Semi-Annual Groundwater Monitoring Reports, (2) After all petroleum-related COCs are demonstrated to be below cleanup levels for four consecutive sampling rounds, monitoring will be discontinued and clean closure with regards to groundwater contamination will be documented in a site closure report, (3) Arsenic and parameters indicative of groundwater redox conditions will be monitored quarterly for one year after approval of the final CAP to assess whether concentrations in wells and piezometers at the site show trends over time. The data will also be reviewed to further evaluate the relationship between arsenic concentrations, the hydrocarbon plume, Bay Mud, or other factors that affect redox conditions and therefore, the solubility of arsenic in groundwater. This data evaluation process which will include statistical and spatial data analysis will be further described in the CAP Work Plan, which will incorporate additional groundwater data that will be collected as part of the ongoing groundwater monitoring program, (4) Assessment of the need for additional application of oxygen release product as a contingency via in situ injection for RU-A (as described in the Phase II Interim Action Work Plan for Building 1063 [MACTEC, 2004a]) if groundwater monitoring data indicates the excavation of source materials and application of oxygen release product within the excavation did not reduce groundwater COCs below cleanup levels, and (5) Abandonment of wells, as applicable, upon regulatory approval.~~

4.3 Criteria for the Evaluation of Corrective Action Alternatives

The three general criteria described in Section 4.1 that were used to screen potential remedial technologies – (1) effectiveness, (2) implementability, and (3) relative cost – are also applied in evaluating and comparing the corrective action alternatives but to a greater degree of detail as follows:

- Effectiveness—Site-Specific Applicability; Ability to Achieve RAOs
- Implementability—Constructability; Timeliness; Impacts to Ongoing Operations and Resources

- Cost—Capital Costs; Long Term O&M Costs; and Total Net Present Value Costs.

These criteria encompass the degree to which the alternative meets the RAOs described in Section 3.1 and (1) mitigates potential adverse affects related to releases of petroleum hydrocarbons at the site; (2) protects human health, ecological receptors, water quality, culturally sensitive areas; (3) complies with State and federal environmental laws; (4) controls long-term risks, source contamination, and volume of contaminants (provides for permanent “clean closure” of the site); and (5) is ~~likely to be~~ acceptable to the regulatory agencies and public stakeholders. The Draft Building 1065 Area CAP ~~will be~~ made available for stakeholder review and comment. All comments received ~~will be~~ considered prior to finalizing the CAP, and comments ~~will be~~ summarized and responded to in a Responsiveness Summary that ~~will be~~ included as Appendix A of ~~the this~~ final CAP ~~document~~.

4.4 Evaluation of Corrective Action Alternatives

The comparative evaluation of corrective action alternatives is presented below and summarized in Table 7 for each of the RUs described above.

4.4.1 Alternative 1—No Action

Alternative 1 provides no additional control or protection to human health or the environment for the contamination that exists within the Building 1065 CAP Area RUs. Groundwater would not be monitored to assess any impacts due to existing contamination and all existing potential exposure pathways would remain uncontrolled. Therefore, this alternative does not prevent visitor, tenant, or resident exposures, does not protect against impacts to groundwater, and therefore does not protect human health, safety, and the environment. The “no action” alternative provides no technical effectiveness, since no remedial action is undertaken and COCs would not be reduced. There are no costs associated with this alternative although it fails to address any site impacts of the petroleum releases.

- Effectiveness—Would not mitigate risks or comply with environmental laws.
- Implementability—Would not be implementable from an administrative perspective because it takes no action to mitigate risks or comply with environmental laws. Easy level of effort to implement from a technical perspective.
- Cost—No cost.

4.4.2 Alternative 2—Capping, Land Use Controls, Groundwater Monitoring

The main components of this alternative are described in Section 4.2.2, and estimated costs associated with its implementation are presented in Tables F-1 ~~and~~, F-3, ~~and F-5~~ of Appendix F for Soil RUs ~~AA, B,~~ and C, respectively. It should be noted that groundwater monitoring is not proposed for ~~Soil RU-B and~~ Soil RU-C because petroleum-related groundwater COCs have not been identified at ~~this~~ ~~these~~ RUs. Alternative 2 maintains existing asphalt and concrete covers over the Soil RUs (A ~~and~~ B, C) and extends the existing caps over limited uncovered portions of Soil RU-~~s~~ ~~A and B~~ to isolate the contaminated soil from human exposure (Plate 14). For Soil RU-A, this alternative provides an alternate option for comparison purposes in the event that the Building 1063 water tank renovation is not implemented ~~and soil can not be accessed for excavation~~. For Soil RU-~~s~~ ~~B and C~~, this alternative would be consistent with the current and planned reuses. Because the contaminated soil is not removed, this alternative includes the development and implementation of LUCs to safeguard the cap, provide advance notice of site conditions in the event of future ground disturbing activity, and restrict future land uses to those

compatible with safeguarding the integrity of the cap. For the purposes of preparing cost estimates for this alternative, it is assumed cap maintenance would continue at a decreasing level of frequency over a period of 30 years. Because the site is in the vicinity of archaeologically sensitive areas, work at this site would be monitored as outlined in Section 5.4. Such monitoring is not expected to significantly impact the associated cost of this alternative. This alternative also includes continued monitoring of existing wells and piezometers at RU-As ~~for with~~ petroleum-related groundwater COCs TPHg and BTEX, arsenic, and redox parameters (as described in Section 4.24.2 and in Table 9) to (a) verify COC concentrations in groundwater are not migrating offsite, and (b) assess whether concentrations of COCs in wells and piezometers at the site show trends over time, verify that contaminant concentrations are decreasing and that contaminants in groundwater are not migrating offsite. ~~Monitoring will also be performed to assess arsenic concentrations and further refine our understanding of factors affecting the occurrence and distribution of dissolved arsenic in groundwater at the site.~~

Capping of contaminants would be protective of human health, safety, and the environment, as it would eliminate the potential for contaminant exposure through soil ingestion, dermal contact, and inhalation. LUCs would also be required to prevent direct contact with the contaminated soil and future land uses inconsistent with levels of contamination remaining on-site and to establish procedures for the management of contaminated soil, if encountered in the future. This alternative is technically effective if caps are maintained and LUCs imposed. Groundwater monitoring would provide a long-term assessment of groundwater quality until cleanup levels are achieved. Although no active treatment of soil will be performed, the potential for migration of COCs from soil into groundwater would be reduced based on the reduced potential for surface water infiltration provided by the cover. Capping with LUCs is readily implementable, particularly because the majority of ~~all three~~ the Soil RUs are already capped with asphalt and concrete. Capping improvements (inspections, indoor air quality monitoring, extending the caps over limited uncovered portions of Soil RUs, improvements to existing pavement) would involve some design and construction improvements.

The estimated costs associated with implementation of the Capping and Land Use Control Alternative for each of the RUs are provided in Appendix F, Tables F-1 ~~and~~, F-3, ~~and F-5~~, and are summarized as follows:

—**Soil and Groundwater RU-A:** Capital Cost of ~~\$299,000~~115,000; 30-Year Annual O&M Cost of ~~\$400,000~~206,000; Total Estimated 30-Year Cost of ~~\$699,000~~321,000 (Table F-1).

—**Soil RU-B:** Capital Cost of \$330,000; 30-Year Annual O&M Cost of \$116,000; Total Estimated 30-Year Cost of \$446,000 (Table F-3).

—**Soil RU-C:** Capital Cost of ~~\$34,000~~50,000; 30-Year Annual O&M Cost of ~~\$20,000~~39,000; Total Estimated 30-Year Cost of ~~\$54,000~~89,000 (Table F-5).

In summary, the Capping and Land Use Control alternative would meet the evaluation criteria as follows:

- Effectiveness—Would mitigate risks and comply with environmental laws, but would not permanently remove COCs to provide ‘clean closure’. However, the majority of the RUs are covered by pavement and buildings and used commercially, and there are no ecological receptors within this area, so this alternative would provide a low cost option for mitigating risks under current reuses until the time when/if the site reuses are modified.
- Implementability—Would be implementable from an administrative perspective because caps and LUCs would be maintained and comply with environmental laws. Easy level of effort to implement from a technical perspective.

- Cost—Low-to-moderate cost.

4.4.3 Alternative 3—Excavation and Offsite Disposal of Soil, Application of In Situ Oxygen Release Product as Necessary, Groundwater Monitoring

The main components of this alternative are described in Section 4.2.3, and estimated costs associated with its implementation are presented in Tables F2 and F-4 of Appendix F for Soil RUs A and B, respectively. Alternative 3 involves excavation and removal of all contaminated soil where COCs are present above cleanup levels from Soil RUs A and B (as feasible based on constraints necessary to preserve Building 1063) (except under walls within Building 1063; Soil RU A), followed by waste characterization, transport to, and disposal of waste materials at an approved offsite disposal facility. For Soil RU A, this alternative assumes that the Building 1063 water tank renovation is implemented and soil can be accessed for excavation. For Soil RU B, this alternative assumes current and future reuse as a parking area, with restoration of paved areas after soil removal. This alternative does not apply to Soil RU-C as described in Section 4.1.7 because soil contamination extends beneath the foundation of existing Building 1040, which is an unreinforced historic brick structure with a 4-foot thick slab foundation that is designated to be preserved. Therefore, excavation of Soil RU-C could not be conducted without significant impacts to the building's structural integrity, and is not considered further for this RU-C. Because the site is in the vicinity of archaeologically sensitive areas, excavation work at RU-A and RU-B would be monitored as outlined in Section 5.4. Such monitoring is not expected to significantly impact the associated cost of this alternative. Based on the definition of Soil RUs presented in Section 3.4.1, the estimated volume of soil in Soil RU-A is 1,070-100 cy and in Soil RU-B is 9,200 cy. During following excavation, confirmation samples would be collected from the excavation floor and sidewalls to ensure that soils exceeding cleanup criteria have been removed. In cases where the excavation could not extend laterally because of constraints regarding preservation of Building 1063, cFor Soil RU A, confirmation samples would be collected from sidewalls to provide a record of potentially remaining contamination since soil would not be excavated from beneath the majority of the building walls. As discussed in Section 5.2.2, remedial decisions will be based on petroleum-related COCs. A LUC may be implemented for soil containing COCs above cleanup levels that cannot be removed by excavation due to technical limitations. This alternative also includes in situ application of an oxygen release product within excavation bottoms as necessary as described in Section 4.2.3 prior to backfilling. A LUC for groundwater will be implemented in this area that will be lifted when groundwater monitoring shows that concentrations of petroleum-related COCs and arsenic are below cleanup levels for four consecutive sampling rounds. An aFor Soil RU A, additional application of oxygen release product via in situ injection (as described in the Phase II Interim Action Work Plan for Building 1063 [MACTEC, 2004a]) may be considered if groundwater monitoring shows the-that excavation of source materials and application of oxygen release product within the excavation has not reduced groundwater COCs to concentrations below cleanup levels. This alternative also includes continued monitoring of existing wells shown in Table 9 at RU-A for petroleum-related groundwater COCs TPHg and BTEX, arsenic, and redox parameters (as described in Section 4.2.3) to (a) verify COC concentrations in groundwater are not migrating offsite, and (b) assess whether concentrations of COCs in wells and piezometers at the site show trends over time. This alternative also includes continued groundwater monitoring of existing wells at Groundwater RU A for petroleum-related COCs (as described in Section 4.2.3) to verify that contaminant concentrations are decreasing and that contaminants in groundwater are not migrating offsite. Groundwater monitoring will also be performed to assess arsenic concentrations and further refine our understanding of factors affecting the occurrence and distribution of dissolved arsenic in groundwater at the site.

Excavation and removal of contaminated soil would be protective of human health, safety, and the environment, because the shallow soil contamination is removed, thereby eliminating potential human and ecological exposures to contaminants. The excavated soil would be transported offsite to a facility approved to manage the waste. This remedy is technically effective and permanent. Contaminated soil is removed, thereby preventing worker and visitor exposures and impacts to groundwater. Although the volume of contaminants will not be reduced because the impacted material will not be treated, potential exposure of workers and the public to contaminated materials during excavation and loading for offsite transport would be mitigated by engineering and dust control measures. This alternative is implementable and no significant obstacles have been identified. Additionally, long term O&M would not be required.

The estimated costs associated with implementation of the Excavation and Offsite Disposal of Soil Alternative for ~~each of the RU-A's~~ isare provided in Appendix F, Tables F-2 ~~and F-4~~, and isare summarized as follows:

~~—Soil and Groundwater RU-A: Capital Cost of \$536,000~~346,900; ~~53-Year Annual O&M Cost of \$170,000~~180,000; Total Estimated ~~53-Year Cost of \$706,000~~526,900 (Table F-2).

~~—Soil RU-B: Capital Cost of \$1,663,000; No Annual O&M Cost; Total Estimated Cost of \$1,663,000 (Table F-4).~~

In summary, the Excavation and Offsite Disposal of Soil Alternative would meet the evaluation criteria as follows:

- Effectiveness—Would mitigate risks and comply with environmental laws and permanently remove the majority of COCs and treat residual contamination via oxygen release product to provide eventual ‘clean closure’ for Soil RU-A. ~~Would mitigate risks and comply with environmental laws and would permanently remove COCs to provide ‘clean closure’ for Soil RU-B. This alternative could only be implemented for Soil RU-A if renovation of Building 1063 is implemented as planned, and~~ would provide a moderate-to-high cost option for permanently mitigating risks under future modified reuses.
- Implementability—Would be implementable from an administrative perspective because it takes action to mitigate risks and comply with environmental laws. High level of effort to implement from a technical perspective.
- Cost—Moderate-to-high cost.

4.5 Recommended-Selected Corrective Action Alternatives

The rationale presented below for selection of the recommended corrective action alternative based on its ability to meet each of the evaluation criteria for each of the RUs is summarized in Table 8.

4.5.1 Soil and Groundwater Remedial Units A—Alternative 3 (Excavation)

The recommended alternative for co-located Soil and Groundwater RUs A is Alternative 3 (Excavation and Offsite Disposal of Soil, Application of In Situ Oxygen Release Product as Necessary, Groundwater Monitoring until petroleum-related COCs are demonstrated to be below cleanup levels for four consecutive sampling rounds). Under this alternative, the majority of petroleum-contaminated soil would be removed and disposed of offsite at an approved disposal facility. Excavation would continue until soil confirmation sampling results indicate that cleanup levels are met within the excavation bottom, and to

the limits of the building walls according to provisions in Section 5.0. In order to treat any residual petroleum contamination and address soils that would be left under the building walls, an in situ oxygen release product would be applied within the excavation prior to backfilling. A LUC will be implemented for groundwater in this area that will be lifted when groundwater monitoring shows concentrations of petroleum-related COCs and arsenic are below cleanup levels for four consecutive sampling rounds. Additional application of oxygen release product via in situ injection may be considered if groundwater monitoring data indicates the excavation of source materials and application of oxygen release product within the excavation has not reduced groundwater COCs to concentrations below cleanup levels. This alternative also includes continued groundwater monitoring of existing wells at Groundwater RU-A shown in Table 9 for petroleum-related COCs (TPHg and BTEX, and arsenic and redox parameters) to (a) verify COC concentrations in groundwater are not migrating offsite, and (b) assess whether concentrations of COCs in wells and piezometers at the site show trends over time to verify that contaminant concentrations are decreasing and that contaminants in groundwater are not migrating offsite. Groundwater samples including QA/QC samples (duplicates, equipment blanks and trip blanks) will be collected on a quarterly basis for one year and semi-annually thereafter. Results will be presented in Presidio-Wide Semi-Annual Groundwater Monitoring Reports. After ~~all~~ petroleum-related COCs TPHg and BTEX, and arsenic are demonstrated to be below cleanup levels for four consecutive sampling rounds, monitoring will be discontinued (subject to RWQCB approval) and clean closure with regards to groundwater contamination will be documented in a site closure report. ~~Arsenic and parameters indicative of groundwater redox conditions will be monitored quarterly for one additional year to assess whether arsenic concentrations in wells and piezometers at the site show trends over time. The data will also be reviewed to further evaluate the relationship between arsenic concentrations, the hydrocarbon plume, Bay Mud, or other factors that affect redox conditions and therefore, the solubility of arsenic in groundwater. This data evaluation process which will include statistical and spatial data analysis will be further described in the CAP Work Plan, which will incorporate additional groundwater data that will be collected as part of the ongoing groundwater monitoring program.~~ Wells will be abandoned, as applicable, upon regulatory approval. In accordance with Task 13 of RWQCB Order R2-2003-0080, a Five-Year Status Report will be completed and submitted to the RWQCB for approval.

The total cost of this alternative is \$~~706,000~~526,900 (Table F-2) as compared to \$~~699,000~~321,000 for Alternative 2 (Capping, LUCs, Groundwater Monitoring; Table F-1), and no costs for Alternative 1 (No Action) which is not protective.

Alternative 3 is recommended for implementation at co-located Soil and Groundwater RUs-A because it is technically effective and takes advantage of the opportunity to remove the majority of contaminated soil from beneath Building 1063 prior to and in coordination with during renovation of the building, is readily implementable and cost-effective. ~~Although~~ Although this alternative has approximately the same is higher in cost as than Alternative 2 (Capping, LUCs, Groundwater Monitoring), contaminated soil is removed permanently from the site and supplemental remediation of residual contamination using in situ oxygen release product would be implemented, thus eliminating the potential for future exposures. In addition, it is assumed that 'clean closure' of these RUs could be achieved ~~via supplemental remediation of residual contamination using in situ oxygen release product after groundwater monitoring indicates concentrations of COCs have decreased below cleanup levels within a period of 3 years.~~

4.5.2 Soil Remedial Unit B—Not Evaluated Alternative 2 (Capping, Land Use Controls)

Because the areal extent of COCs in shallow soil at RU-B has not been fully delineated, a corrective action cannot be selected in this CAP. Further investigation and evaluation and selection of remedial alternatives will be addressed in the RAP for Fill Site 6B.

The recommended alternative for Soil RU-B is Alternative 2 (Capping, LUCs). Under this alternative, the existing asphalt parking area would serve as a cap to isolate contaminated soil from exposure to potential receptors. The asphalt would be inspected for improvements, and pavement that is deteriorated would be replaced. Uncovered portions of Soil RU-B (landscaped areas) would be capped by placement of geomembrane fabric and clean soil or decorative bark (or other similar ground cover material) (Plate 16). This alternative would be consistent with the current and future reuse of the parking area. Because the contaminated soil is not removed, this alternative includes the development and implementation of LUCs to safeguard the cap, provide advance notice of site conditions in the event of future ground disturbing activity, and restrict future land uses to those compatible with safeguarding the integrity of the cap. Because of some uncertainty in the extent of fill material at RU-B, the LUC area will encompass the entire parking area as is shown on Plate 16. Fill areas that lie outside of the LUC area will be addressed in the RAP for Fill Site 6B. For the purposes of preparing cost estimates for this alternative, it is assumed administrative management of the LUC and cap inspection and maintenance would be performed on a yearly basis for a period of 30 years (the maximum time period for costing annual long term operations and maintenance costs recommended by USEPA [USEPA, 2000]). This alternative does not include groundwater monitoring because no petroleum related COCs have been identified in groundwater at RU-B above cleanup levels. The total cost of this alternative is \$446,000 (Table F-3) as compared to \$1,663,000 for Alternative 3 (Excavation; Table F-4), and no costs for Alternative 1 (No Action) which is not protective.

Alternative 2 is recommended for implementation at Soil RU-B because it is technically effective and readily implementable and cost-effective. Contamination in this RU occurs at relatively low levels over an extensive area (9,200 cy), is varied and ubiquitous within fill material in soil, does not appear to have impacted groundwater, and occurs beneath an asphalt paved parking lot that is already serving as a cap and mitigating potential exposures. In addition LUCs would restrict future land uses to those compatible with safeguarding the integrity of the cap. This alternative is much lower in cost than Alternative 3 (Excavation), under which contaminated soil is permanently removed from the site.

4.5.3 Soil Remedial Unit C—Alternative 2 (Capping, Land Use Controls)

The recommended alternative for Soil RU-C is Alternative 2 (Capping, LUCs). Under this alternative, the northwestern portion of the Building 1040 foundation will serve as a cap to isolate contaminated soil from exposure to potential receptors. Under this alternative, the foundation and adjacent area would be inspected for improvements. This alternative would be consistent with the current and future reuse of this historic building that will be preserved but not occupied in the future and potentially occupied in the future. Because the contaminated soil is not removed, this alternative includes the development and implementation of LUCs to safeguard the cap, provide advance notice of site conditions in the event of future ground disturbing activity, and restrict future land uses to those compatible with safeguarding the integrity of the cap. The LUC Area for RU-C is shown on Plate 16. For the purposes of preparing cost estimates for this alternative, it is assumed administrative management of the LUC and cap inspection and maintenance would be performed on a yearly basis for a period of 30 years (the maximum time period for costing annual long-term operations and maintenance costs recommended by USEPA [USEPA, 2000]). This alternative does not include groundwater monitoring because no petroleum-related COCs have been identified in groundwater at RU-C above cleanup levels. In accordance with Task 13 of RWQCB Order R2-2003-0080, a Five-Year Status Report will be completed and submitted to the RWQCB for approval. The total cost of this alternative is \$54,000~~\$89,000~~ (Table F-53); Alternative 3 (Excavation) could not be implemented without damaging the building, and there are no costs for Alternative 1 (No Action) which is not protective.

Alternative 2 is recommended for implementation at Soil RU-C because it is technically effective and readily implementable and cost-effective. Contamination in this RU occurs at relatively low levels and is

limited in extent (90 cy), does not appear to have impacted groundwater, and occurs beneath the foundation of an existing historic building area that is already serving as a cap and mitigating potential exposures. In addition LUCs would restrict future land uses to those compatible with safeguarding the integrity of the cap. This alternative has a low relative cost.

4.5.4 Closure of USTs, ASTs, and FDS Lines

Because it appears there is no residual petroleum-related contamination associated with UST 1027, FDS lines on ~~Grand Girard~~ and Edie Roads (FDS line segments BR8-1 and BR16-1), Water Storage Tanks 1047.1, 1047.2, 1047.3, 1047 ~~Hydraulic Tank and Elevator Pit~~, Building 1062 Hot Well/Sump, UST 1047.4, no further action is needed for these units and they can be processed for regulatory closure upon RWQCB approval of this CAP. As part of the implementation of this CAP, it is anticipated that residual contamination associated with ASTs 1040.1 and 1040.2, USTs 1065.1, 1065.2, 1065.3 and 1065.4, and the Birmingham Road FDS lines (un-named FDS line segment) will be addressed and that these units can also be closed upon completion of the corrective actions required by the Final CAP. The request for closure will be presented in the Completion Report documenting implementation of the selected corrective actions.

5.0 IMPLEMENTATION OF CORRECTIVE ACTION ALTERNATIVES

This section describes the tasks associated with implementation of the recommended alternatives, applicable laws and regulatory requirements, and the anticipated schedule. Implementation of the CAP alternatives including confirmation sampling, groundwater monitoring, and archaeological monitoring are also discussed below.

5.1 Corrective Action Implementation

The corrective actions set forth in Section 4.5.1 through 4.5.3 for Soil and Groundwater RUs-A, ~~Soil RU-B~~, and Soil RU-C, respectively, will be implemented by the Trust. Upon regulatory agency approval of the Final CAP, a implementation Work Plan (called CAP Work Plan) will be prepared for ~~these~~ RUs A and C. This CAP Work Plan will include the details of the soil confirmation sampling and groundwater monitoring programs described in Section 5.5 and will be coordinated with implementation Design Work Plans for the Building 1063 water tank recycling renovation project located within the Building 1065 CAP Area.

5.2 Soil Confirmation Sampling Program

Confirmation soil sampling will be conducted within Soil RU-A under the recommended corrective action alternative (Excavation). It is anticipated that after the impacted materials have been removed from within the Building 1063 footprint, the exposed land surface will consist of excavation “bottom” with the perimeter of the excavation having “sidewalls.”

Bottom sampling will be based on the ~~estimated-actual~~ size of the excavation with a minimum of one sample per excavation and at least one sample per 625 square feet (sf). A 25- by 25-foot sampling grid will be used to guide the collection of excavation bottom samples. Sidewalls will be sampled at the midpoint of the excavation’s height (using best professional judgment for biasing sample locations to any visibly stained soil layers) every 25 feet of its lateral extent or to obtain at least one sample per excavation sidewall. The actual physical dimensions of the excavation will determine the number of bottom and sidewall samples collected. At least one bottom and four sidewall samples will be collected from the excavation.

All confirmation samples from the excavation will be analyzed for the following COCs identified for the co-located Soil and Groundwater RUs A in Section 3.4.1 and 3.4.2:

- PAHs by EPA Method 8270C;
- TPHg by EPA Method 8015 modified;
- TPHd and TPHfo by EPA Method 8015 modified and EPA Method 3630A - Silica Gel Cleanup;
- VOCs including the COCs BTEX and 2-hexanone by EPA Method 8260B; and
- Title 22 metals including the COCs arsenic, cadmium, lead, and zinc (EPA 6000-7000 series).

The goal of the confirmation sampling is to demonstrate removal of soil contamination associated with petroleum-related releases. As discussed in Section 4.4.3, a portion of the soil contamination within the Building 1063 Soil RU-A ~~will~~may be inaccessible for excavation beneath building walls and footings.

Therefore, confirmation sampling of sidewalls will be conducted to provide a record of potentially remaining contamination since soil would not be excavated from beneath the majority of the building walls.

5.3 Applicable State and Federal Laws and Regulatory Requirements

Implementation of the selected corrective action alternatives will comply with applicable state and federal laws and regulations including the requirements of Title 23, Division 3, Chapter 16, Article 11, which are the primary regulations establishing the requirements and standards for petroleum-related corrective action in the State of California. The alternatives will also comply with applicable laws and regulations regarding management and disposal of excavated soil, including transport to and treatment at regulated and permitted facilities. As detailed in the RWQCB Order, the Building 1065 CAP Area is a known petroleum contamination site requiring preparation and implementation of this CAP meeting the requirements of 23 CCR § 2725 (2004). The RWQCB Order presents cleanup standards as SCRs for the protection of human health, ecological receptors, and water quality, which have been used to set the applicable CAP cleanup levels. In addition, the RWQCB's *Transmittal of Final Site Cleanup Requirements for Petroleum Impacted Soils* (RWQCB, 1996) and the RWQCB Water Quality Control Plan for the San Francisco Bay Region (known as the Basin Plan) pertaining to water quality within the state, have been taken into account in establishing the CAP cleanup levels.

The Presidio as a whole is within the GGNRA and is listed in the National Register of Historic Places as a NHL, which affords its historic resources and cultural landscapes certain protection under the NHPA. The NPS and Trust Programmatic Agreements which set forth the procedures to implement the historic compliance process of Section 106 of the NHPA will be followed. In addition, archeological sites and resources are known to exist or may be discovered within the Presidio. During corrective action implementation, the Trust will comply with applicable provisions of the Archeological and Historic Preservation Act (AHPA) and the Native American Graves Protection and Repatriation Act (NA GPRA). Other federal and state statutes, such as the federal and state Endangered Species Acts (ESA and CESA), and the Migratory Bird Treaty Act (MBTA), also provide standards for protection of natural resources found on the Presidio that will be followed during this corrective action. The corrective action will be completed in a manner consistent with land uses established by the PTMP, NPS Management Policies, and the Presidio Vegetation Management Plan (Trust and NPS, 2001).

With regard to soil excavation and disposal, state laws and regulations implement the federal Resource Conservation and Recovery Act (RCRA) standards and are applicable to the corrective actions at the Building 1065 CAP Area. These provisions include standards for properly storing, handling and transporting excavated soils that may contain hazardous constituents. These regulations also set standards for testing of potential hazardous wastes prior to management and proper off-site disposal.

The impacted soil at the Building 1065 CAP Area is not believed to be hazardous waste. The transport and disposal of non-hazardous waste that may be generated during the corrective action will be performed in accordance with the pertinent sections of Title 27 of the California Code of Regulations, which addresses the proper management of solid wastes.

The corrective actions at the Building 1065 CAP Area take into account the RWQCB Basin Plan policy of no loss of wetlands as well as Presidio wetlands resources (NPS and Trust, 2003). Any applicable discharge prohibitions and erosion control measures will protect surface water and wetland resources. Also, Bay Area Air Quality Management District (BAAQMD) regulations pertinent to dust suppression and onsite air monitoring during excavation work will be met to prevent air quality impacts from the selected remedial actions. Although not anticipated to be present, if unknown USTs are found during remedial activities, removal will comply with applicable state and local requirements.

5.4 Archaeological Monitoring

Because the site is in proximity to areas known to be archaeologically sensitive, remedial work will be conducted in accordance with NHPA and AHPA. Work at this site will be monitored per the Programmatic Agreement for the Presidio between the Trust and the State Historic Preservation Officer. Work will only be performed following coordination with and approval by Trust and NPS historians and archaeologists. If items of archeologically or historically sensitive importance are found or suspected to be present, field personnel will contact the Trust immediately.

Through the Trust Project Manager, the corrective action will be coordinated with Trust and NPS naturalists, historians, and archaeologists regarding sensitive areas that may exist at or near the Building 1065 CAP Area and take appropriate precautions during the field investigation.

5.5 Groundwater Monitoring

Groundwater monitoring for petroleum-related COCs is included as part of the recommended alternative for co-located Soil and Groundwater RUs A as described in Section 4.5.1. [Table 9 summarizes the proposed groundwater monitoring program.](#)

Groundwater samples will be collected from [existing wells indicated in Table 9 quarterly for the first year for petroleum-related COCs TPHg and BTEX, arsenic and redox parameters; semi-annually thereafter for petroleum-related COCs \(TPHg and BTEX\); and annually thereafter for arsenic and redox parameters](#) ~~four existing downgradient monitoring wells and piezometers (1065PZ1A, 1065PZ1B, 1065MW101A, and 1065MW102A) and one existing upgradient well (1065MW9A) on a quarterly basis for one year and on a semi-annual basis thereafter.~~ During each groundwater sampling event, water levels will be measured in all existing onsite groundwater monitoring wells and piezometers. Groundwater samples collected from ~~these~~ wells and piezometers [indicated in Table 9](#) will be analyzed for the following petroleum-related groundwater COCs:

- TPHg by EPA Method 8015 modified
- BTEX by EPA Method 8021B.
- [Dissolved arsenic, iron, manganese, and aluminum \(EPA Method 6010\)](#)
- [Field parameters including DO, ORP, specific conductance, and pH.](#)

~~In addition, groundwater samples will be collected from eleven wells (1065PZ1A, 1065PZ1B, 1065PZ2A, 1065PZ3A, 1065PZ4A, 1065PZ5A, 1065PZ6A, 1065MW9A, 1065MW10A, 1065MW101A, and 1065MW102A) on a quarterly basis for one year to assess whether arsenic concentrations in wells and piezometers at the site show trends over time and to further evaluate the relationship between arsenic concentrations, the hydrocarbon plume, Bay Mud, or other factors that affect redox conditions and therefore, the solubility of arsenic in groundwater. Samples collected from these wells will be analyzed for the following parameters:~~

- ~~—Dissolved arsenic, iron, manganese, and aluminum (EPA 6010-6020)~~
- ~~—Sulfate, Nitrate as N, and Nitrite as N (EPA 300.0/SW9056)~~
- ~~—Sulfide (EPA 376.2/SW9030)~~
- ~~—Dissolved gases (including methane) (RSK 175) by GC-TCD/FID~~

~~—TOC (SW 9060)~~

~~—Field parameters including DO, pH, specific conductance, and pH.~~

~~Iron, manganese, sulfide, sulfate, nitrate as N, nitrite as N, and dissolved gases will be analyzed and DO, and pH will be field measured to evaluate the redox state of the groundwater and TOC will be evaluated to assess the relative concentrations of organic compounds available for biodegradation. Aluminum will be monitored for QC purposes, to evaluate if there has been breakthrough of the filters used for sampling. Groundwater samples and QA/QC samples (duplicates, equipment blanks, and trip blanks), will be collected and analyzed in accordance with the Presidio-wide Quality Assurance Project Plan (Tetra Tech, 2001). Table 9 summarizes the proposed groundwater monitoring program.~~

~~For TPH and BTEX, if~~ Once concentrations of TPHg, BTEX, and arsenic are below cleanup levels for four consecutive sampling rounds, it is proposed that monitoring for those COCs cease. ~~Arsenic will be monitored for four sampling events to evaluate if concentrations show trends and to refine the conceptual model for arsenic in groundwater. After cessation of the groundwater monitoring program, and~~ all wells at the site will be abandoned pursuant to regulatory approval. The details regarding the ground water monitoring program will be presented in the CAP Work Plan, which will be submitted for regulatory review and approval. The Work Plan will include a detailed sampling and analysis plan, the data evaluation and review process, and the criteria for the monitoring program duration, reduction, and revision.

5.6 UST, AST, and FDS Line Closures

Because it appears there is no residual petroleum-related contamination associated with UST 1027, FDS lines on ~~Grand Girard~~ and Edie Roads (FDS line segments BR8-1 and BR16-1), Water Storage Tanks 1047.1, 1047.2, 1047.3, ~~1047 Hydraulic Tank and Elevator Pit~~, Building 1062 Hot Well/Sump, UST 1047.4, these units can be closed under this CAP. This document represents a request for closure of these units. After implementation of this CAP, it is anticipated that residual contamination associated with ASTs 1040.1 and 1040.2, USTs 1065.1, 1065.2, 1065.3 and 1065.4, and the Birmingham Road FDS lines (un-named FDS line segment) will be addressed and that these units can also be closed. Requests for closures of ASTs 1040.1 and 1040.2, USTs 1065.1, 1065.2, 1065.3 and 1065.4, and the Birmingham Road FDS lines will be presented in a report documenting implementation of the Building 1065 CAP Area corrective actions (Completion Report).

5.7 Implementation Schedule

~~In accordance with the RWQCB Order, construction activities associated with implementation of this CAP will commence by May 1, 2006.~~ The Trust plans to implement the corrective action alternatives for the RUs in two different phases as follows:

Soil and Groundwater RUs A: Excavation of soil from ~~within the Building 1063 footprint~~ will be implemented ~~according prior to and and~~ in coordination ~~with implementation of~~ the Building 1063 ~~recycled water tank treatment plant construction recycling renovation~~ project.

Soil RUs B and C: Inspection, capping improvements, and implementation of LUCs for ~~these~~ RUs will be implemented according to the schedule presented in the Building 1065 Area CAP Work Plan for ~~RU-C these areas~~.

Upon regulatory agency approval of the Final CAP, the Trust will implement the CAP according to the following proposed schedule milestones in calendar days from the date of the Final CAP:

- 0 Days – Submittal of the Final CAP to RWQCB
- 120 Days – Submittal of the Implementation Work Plan to RWQCB
- 150 Days – Remediation Construction Contract Awarded
- 180 Days – Obtain RWQCB Approval on Implementation Work Plan

210 Days - Construction Start Date~~Work Plan for the recommended alternatives will be prepared and submitted to the RWQCB within 6 months of the date of the Final CAP.~~

As required by the RWQCB Order, a Completion Report documenting implementation of the Building 1065 CAP Area corrective actions, construction completion, and a summary of the first round of groundwater monitoring results will be issued ~~on or before June 1, 2007~~within six months of the construction completion date. The Completion Report will also include the Site-Specific Addendum to the LUCMRR as described in Section 4.1.2.

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TABLES

Table 1. Summary of Chemicals Detected in Soil Within Freshwater Ecological Protection Zone
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

Chemical	Summary of Soil Analytical Data			Cleanup Level for Soil Less Than 5 Feet Above Groundwater (Petroleum Hydrocarbons) (mg/kg)	Residential Land Use Cleanup Level (mg/kg)	Commercial/ Recreational Land Use Cleanup Level (mg/kg)	FEPZ / Ecological Buffer Zone Cleanup Levels (mg/kg)	Lowest Applicable Cleanup Level in FEPZ / Ecological Buffer Zone ^(c) (mg/kg)	Exceeds Lowest Applicable Cleanup Level (Yes/No?)				
	Number of Samples Detected/ Number of Samples Analyzed	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)										
Total Petroleum Hydrocarbons (TPH)													
TPH Gasoline (C7-C12)	2/32	1.8	4	100	1b	1030	1b	2400	1b	11.6	2	11.6	No
TPH Diesel (C12-C24)	14/40	1.4	200	115	1b	1380	1b	3200	1b	115	1,2	115	Yes
TPH Unknown Diesel Hydrocarbon	9/14	13	180	115	1b	1380	1b	3200	1b	115	1,2	115	Yes
TPH Fuel Oil (C24-C36)	20/40	27	930	160	1b	1900	1b	4500	1b	144	1,2	144	Yes
PAHs													
Anthracene	1/2	0.06	0.06	308	1b	5900	1b	13800	1b	40	1a	40	No
Benzo(a)anthracene	1/5	0.096	0.096	8	1b	0.43	1b	1	1b	40	1a	0.43	No
Benzo(a)pyrene	1/5	0.075	0.075	3	1b	0.04	1b	0.1	1b	40	1a	0.04	No
Benzo(b)fluoranthene	1/5	0.17	0.17	23	1b	0.43	1b	1	1b	40	1a	0.43	No
Benzo(g,h,i)perylene	1/2	0.13	0.13	5040	1b	620	1b	1400	1b	40	1a	40	No
Benzo(k)fluoranthene	1/5	0.058	0.058	23	1b	0.43	1b	1	1b	40	1a	0.43	No
Chrysene	2/5	0.058	0.23	54	1b	4.3	1b	10	1b	40	1a	4.3	No
Fluoranthene	1/5	0.16	0.16	316	1b	820	1b	1900	1b	40	1a	40	No
Phenanthrene	1/2	0.086	0.086	86	1b	600	1b	1400	1b	40	1a	40	No
Pyrene	2/5	0.058	0.11	241	1b	620	1b	1400	1b	40	1a	40	No
VOCs													
Acetone	7/8	0.039	0.095	--	--	0.24	1a	0.24	1a	68000	1a	0.24	No
Benzene	2/38	0.003	0.037	0.005	1b	0.6	1b	1.5	1b	--	--	0.005	Yes
Carbon disulfide	2/8	0.004	0.007	--	--	200	1a	200	1a	14000	1a	200	No
Ethylbenzene	2/38	0.003	0.005	13	1b	840	1b	1900	1b	--	--	13	No
2-Butanone	1/8	0.006	0.006	--	--	3.8	1a	3.8	1a	--	--	3.8	No
1,1,2,2-Tetrachloroethane	1/31	0.005	0.005	--	--	0.009	1a	0.018	1a	--	--	0.009	No
Toluene	3/38	0	0.001	1	1b	530	1b	1200	1b	--	--	1	No
Xylenes (total)	1/29	0.005	0.005	33	1b	1080	1b	2500	1b	--	--	33	No
Metals													
Antimony	2/4	0.19	0.67	--	--	29	1a	70	1a	5	1a	5	No
Arsenic	4/4	1.6	1.8	--	--	0.36	1a	0.88	1a	64	1a	5.9	No
Barium	4/4	65	690	--	--	5000	1a	12000	1a	500	1a	500	Yes
Beryllium	4/4	0.16	0.48	--	--	140	1a	350	1a	10	1a	10	No
Cadmium	4/4	0.32	1.9	--	--	1.7	1a	4.2	1a	0.23	1a	1.7	Yes
Chromium	4/4	62	74	--	--	1200	1a	2800	1a	23	1a	120	No
Cobalt	4/4	8	9.4	--	--	4000	1a	10000	1a	48	1a	48	No
Copper	4/4	8.5	28	--	--	225	3	225	3	120	1a	120	No
Lead	19/19	2.7	4200	--	--	400	1a	500	1a	300	1a	300	Yes
Mercury	3/4	0.071	0.27	--	--	20	1a	52	1a	1.6	1a	1.6	No
Molybdenum	2/4	0.28	0.43	--	--	360	1a	870	1a	300	1a	300	No
Nickel	4/4	40	52	--	--	1400	1a	3500	1a	71	1a	71	No
Selenium	3/4	0.61	0.64	--	--	360	1a	870	1a	1.1	1a	1.1	No
Silver	3/4	0.75	1	--	--	360	1a	870	1a	2	1a	2	No
Thallium	3/4	0.031	0.58	--	--	5.7	1a	14	1a	1	1a	1	No
Vanadium	4/4	39	59	--	--	650	1a	1600	1a	5	1a	92	No
Zinc	4/4	48	970	--	--	22000	1a	52000	1a	50	1a	66	Yes

**Table 1. Summary of Chemicals Detected in Soil Within Freshwater Ecological Protection Zone
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California**

Chemical	Summary of Soil Analytical Data			Cleanup Level for Soil Less Than 5 Feet Above Groundwater (Petroleum Hydrocarbons) (mg/kg)	Residential Land Use Cleanup Level (mg/kg)	Commercial/Recreational Land Use Cleanup Level (mg/kg)	FEPZ / Ecological Buffer Zone Cleanup Levels (mg/kg)	Lowest Applicable Cleanup Level in FEPZ / Ecological Buffer Zone ^(c) (mg/kg)	Exceeds Lowest Applicable Cleanup Level (Yes/No?)
	Number of Samples Detected/ Number of Samples Analyzed	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)						

mg/kg

RWQCB ESL

PRG

Milligrams per kilogram.

Regional Water Quality Control Board Environmental Screening Level (RWQCB, 2005).

Preliminary Remediation Goal (USEPA, 2004).

^a Listed chemicals are those detected in soil remaining at the site following previous corrective action soil removal programs.

^b Cleanup levels selected from the following:

1a) Presidio-wide Cleanup Level Document (PWCLD; *EKI, 2002*), 7-2.

1b) Presidio-wide Cleanup Level Document (PWCLD; *EKI, 2002*), Table 7-5.

2) Development of Freshwater TPH-diesel and TPH-fuel oil Point of Compliance Concentrations (BBL, 2004)

3) RWQCB Soil ESL (lowest of human toxicity and indoor air impacts; *RWQCB, 2005*)

^c The lowest of residential land use or FEPZ/ecological buffer zone cleanup levels were selected, unless for metals, the background level was higher, then the background level was selected as the cleanup level.

(s) Surrogate cleanup level for 2-hexanone is ESL for MIBK

Groundwater (less than 5 feet above groundwater).

-- For chemicals with no cleanup levels, there are no Presidio cleanup levels, RWQCB ESLs, or USEPA PRGs.

Checked _____

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**Table 2. Summary of Chemicals Detected in Soil Outside of Freshwater Ecological Protection Zone
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California**

Chemical	Summary of Soil Analytical Data			Cleanup Level for Soil Less Than 5 Feet Above Groundwater (Petroleum Hydrocarbons) (mg/kg)		Residential Land Use Cleanup Level (mg/kg)		Commercial/ Recreational Land Use Cleanup Level (mg/kg)		Lowest Applicable Cleanup Level Outside FEPZ / Ecological Buffer Zone ^(c) (mg/kg)	Exceeds Lowest Applicable Cleanup Level (Yes/No?)
	Number of Samples Detected/ Number of Samples Analyzed	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)								
Total Petroleum Hydrocarbons (TPH)											
TPH Gasoline (C7-C12)	9/108	0.026	30000	100	1b	1030	1b	2400	1b	100	Yes
TPH Diesel (C12-C24)	36/161	0.37	250	115	1b	1380	1b	3200	1b	115	No
Diesel C12-C24 (SGCU)	2/4	2.6	5.9	115	1b	1380	1b	3200	1b	115	No
TPH Unknown Diesel Hydrocarbon	19/92	1.4	2000	115	1b	1380	1b	3200	1b	115	Yes
TPH Fuel Oil (C24-C36)	52/153	0.73	1300	160	1b	1900	1b	4500	1b	160	Yes
TPH Total Petroleum Hydrocarbons (immunoassay)	1/19	<700	<700	160	1b	1900	1b	4500	1b	160	Yes
PAHs											
Acenaphthene	10/10	0.006	0.029	--	--	2700	1b	6600	1b	2700	No
Acenaphthylene	12/12	0.006	0.04	--	--	--	--	--	--	--	No
Anthracene	13/14	0.006	0.041	308	1b	5900	1b	13800	1b	308	No
Benzo(a)anthracene	12/21	0.003	0.11	8	1b	0.43	1b	1	1b	0.43	No
Benzo(a)pyrene	14/21	0.004	0.12	3	1b	0.04	1b	0.1	1b	0.04	Yes
Benzo(b)fluoranthene	13/21	0.002	0.095	23	1b	0.43	1b	1	1b	0.43	No
Benzo(b+k)flouranthene, Total	2/2	0.1	0.12	23	1b	0.43	1b	1	1b	0.43	No
Benzo(g,h,i)perylene	12/14	0.002	0.11	5040	1b	620	1b	1400	1b	620	No
Benzo(k)fluoranthene	11/21	0.002	0.044	23	1b	0.43	1b	1	1b	0.43	No
Chrysene	14/31	0.002	0.15	54	1b	4.3	1b	10	1b	4.3	No
Dibenzo(a,h)anthracene	12/12	0.002	0.072	--	--	0.078	1a	0.19	1a	0.078	No
Fluoranthene	14/30	0.003	0.38	316	1b	820	1b	1900	1b	316	No
Fluorene	10/10	0.0057	0.029	60	1b	770	1b	1800	1b	0.0057	Yes
Indeno(1,2,3-cd)pyrene	13/18	0.003	0.087	--	--	0.27	1a	0.65	1a	0.27	No
Naphthalene (ug/Kg)	5/20	0.0034	0.017	9	1b	480	1b	1100	1b	9	No
Phenanthrene (mg/kg)	13/14	0.002	0.079	86	1b	600	1b	1400	1b	86	No
Pyrene (mg/kg)	14/20	0.001	0.39	241	1b	620	1b	1400	1b	241	No
PAH's, Total (mg/kg)	4/26	5	5	--	--	--	--	--	--	--	No
VOCs											
Acetone (mg/kg)	63/87	0.004	0.101	--	--	0.24	1a	0.24	1a	0.24	No
Benzene (mg/kg)	12/137	0.001	2.4	0.005	1b	0.6	1b	1.5	1b	0.005	Yes
Bromoform (mg/kg)	4/87	0.02	0.036	--	--	2.2	1a	2.2	1a	2.2	No
2-Hexanone (mg/kg)	3/87	0.004	730	--	--	2.7	3s	2.7(1)	3s	2.7	Yes
Carbon disulfide (mg/kg)	4/87	0.003	0.008	--	--	200	1a	200	1a	0	No
Dibromochloromethane (mg/kg)	1/87	0.001	0.001	--	--	0.019	1a	0.058	1a	0.019	No
Chloroethane (mg/kg)	2/87	0.001	0.001	--	--	0.63	1a	0.85	1a	0.63	No
Ethylbenzene (mg/kg)	3/137	0.006	28	13	1b	840	1b	1900	1b	13	Yes
Methylene chloride (mg/kg)	15/87	0.001	0.007	--	--	0.076	1a	0.076	1a	0.076	No
Toluene (mg/kg)	6/137	0.001	3.7	1	1b	530	1b	1200	1b	1	Yes
Xylenes (m&p-) (mg/kg)	6/86	0.003	21	33	1b	1080	1b	2500	1b	33	No
Xylenes (o-) (mg/kg)	2/89	0.001	0.006	33	1b	1080	1b	2500	1b	33	No
Xylenes (total) (mg/kg)	4/51	0.001	0.316	33	1b	1080	1b	2500	1b	33	No
Metals											
Antimony (mg/kg)	6/60	0.28	19	--	--	29	1a	70	1a	29	No
Arsenic (mg/kg)	19/62	0.66	6.4	--	--	0.36	1a	0.88	1a	5.9	Yes
Barium (mg/kg)	60/60	21	300	--	--	5000	1a	12000	1a	5000	No

**Table 2. Summary of Chemicals Detected in Soil Outside of Freshwater Ecological Protection Zone
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California**

	Summary of Soil Analytical Data									Lowest Applicable Cleanup Level Outside FEPZ / Ecological Buffer Zone ^(c)	Exceeds Lowest Applicable Cleanup Level (Yes/No?)
	Number of Samples Detected/ Number of Samples Analyzed	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)								
Chemical				Cleanup Level for Soil Less Than 5 Feet Above Groundwater (Petroleum Hydrocarbons)	(mg/kg)	Residential Land Use Cleanup Level (mg/kg)		Commercial/ Recreational Land Use Cleanup Level (mg/kg)			
Beryllium (mg/kg)	60/62	0.12	0.57	--	--	140	1a	350	1a	140	No
Cadmium (mg/kg)	10/65	0.3	2.5	--	--	1.7	1a	4.2	1a	1.7	Yes
Chromium (mg/kg)	65/65	32	140	--	--	1200	1a	2800	1a	1200	No
Cobalt (mg/kg)	60/60	4.3	21	--	--	4000	1a	10000	1a	4000	No
Copper (mg/kg)	62/62	4.8	130	--	--	225	3	225	3	225	No
Iron (mg/kg)	2/2	13900	16400	--	--	--	--	--	--	--	No
Lead (mg/kg)	51/88	1.4	3600	--	--	400	1a	500	1a	400	Yes
Manganese (mg/kg)	2/2	156	181	--	--	1800	4	19000	4	1800	No
Mercury (mg/kg)	41/62	0.008	0.51	--	--	20	1a	52	1a	20	No
Molybdenum (mg/kg)	3/60	0.28	0.29	--	--	360	1a	870	1a	360	No
Nickel (mg/kg)	65/65	21	120	--	--	1400	1a	3500	1a	1400	No
Selenium (mg/kg)	13/62	0.1	0.91	--	--	360	1a	870	1a	360	No
Silver (mg/kg)	6/60	0.022	0.31	--	--	360	1a	870	1a	360	No
Thallium (mg/kg)	7/60	0.031	0.48	--	--	5.7	1a	14	1a	5.7	No
Vanadium (mg/kg)	62/62	30	83	--	--	650	1a	1600	1a	650	No
Zinc (mg/kg)	65/65	20	1100	--	--	22000	1a	52000	1a	22000	No

mg/kg	Milligrams per kilogram.
RWQCB ESL	Regional Water Quality Control Board Environmental Screening Level (<i>RWQCB, 2005</i>).
PRG	Preliminary Remediation Goal (<i>USEPA, 2004</i>).

^a All potentially detected chemicals in soil at the Building 1065 Area are listed.

^b Cleanup levels selected from the following:

1a) Presidio-wide Cleanup Level Document (PWCLD; *EKI, 2002*), 7-2.

1b) Presidio-wide Cleanup Level Document (PWCLD; *EKI, 2002*), Table 7-5.

3) RWQCB soil ESL (lowest of human toxicity and indoor air impacts) (RWQCB, 2005).

4) Soil PRG (USEPA, 2004)

^c Residential land use cleanup levels were selected, unless for metals, the background level was higher, then the background level was selected as the applicable cleanup level.

(s) Surrogate cleanup level for 2-hexanone is ESL for MIBK

Groundwater (less than 5 feet above groundwater).

-- For chemicals with no cleanup levels, there are no Presidio cleanup levels, RWQCB ESLs, or USEPA PRGs.

Checked _____

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Table 3. Summary of Chemicals and Applicable Groundwater Cleanup Levels - 2004 Groundwater Monitoring Data
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

Chemicals	Summary of Groundwater Analytical Data ⁽¹⁾				Lowest Applicable Cleanup Level	Exceeds Cleanup Level?	
	Number of Samples Detected / Number of Samples Analyzed	Minimum Detected Concentration (µg/L)	Maximum Detected Concentration (µg/L)	Human Health Drinking Water Cleanup Level (µg/L)			Ecological Surface Water Cleanup Level (µg/L)
Freshwater ECO Zone							
Total Petroleum Hydrocarbons (TPH)							
TPH as Gasoline (Carbon Range C ₇ -C ₁₂)	0/14	0	0	770	443	443	No
TPH as Diesel (Carbon Range C ₁₂ -C ₂₄)	0/4	0	0	880	443	443	No
TPH as Fuel Oil (Carbon Range C ₂₄ -C ₃₆)	0/4	0	0	1,200	443	443	No
Volatile Organic Compounds							
Benzene	0/7	0	0	1	1.2	1	No
Toluene	0/7	0	0	150	490	150	No
Ethylbenzene	0/7	0	0	300	845	300	No
Total Xylenes	0/7	0	0	1,750	318	318	No
MTBE	0/7	0	0	13	--	13	No
Metals							
Arsenic	1/4	14	14	10	150	10	Yes
Cadmium	0/4	0	0	5	1.1	1.1	No
Chromium	2/4	24	31	50	180	50	No
Copper	3/4	2.1	3.3	1,000	9	9	No
Iron	1/1	120	120	--	--	--	No
Lead	0/4	0	0	15	2.5	2.5	No
Nickel	0/4	0	0	100	52	52	No
Zinc	0/4	0	0	5,000	120	120	No
Total Dissolved Solids	4/4	480	670	--	--	--	No
Outside Freshwater ECO Zone							
Total Petroleum Hydrocarbons (TPH)							
TPH as Gasoline (Carbon Range C ₇ -C ₁₂)	4/39	53	230	770	NA	770	No
TPH as Diesel (Carbon Range C ₁₂ -C ₂₄)	0/39	0	0	880	NA	880	No
TPH as Fuel Oil (Carbon Range C ₂₄ -C ₃₆)	0/39	0	0	1,200	NA	1,200	No
Volatile Organic Compounds							
Benzene	0/39	0	0	1	NA	1	No
Toluene	1/39	1.9	1.9	150	NA	150	No
Ethylbenzene	1/39	1.2	1.2	300	NA	300	No
Total Xylenes	2/39	0.76	0.78	1,750	NA	1,750	No
MTBE	4/39	2.4	5	13	NA	13	No
Metals							
Arsenic	17/43	6.8	25	10	NA	10	Yes
Cadmium	0/43	0	0	5	NA	5	No
Chromium	16/43	10	42	50	NA	50	No
Copper	8/43	1	19	1,000	NA	1,000	No
Iron	13/24	100	18000	--	NA	--	No
Lead	0/44	0	0	15	NA	15	No
Nickel	1/43	25	25	100	NA	100	No
Zinc	3/43	25	88	5,000	NA	5,000	No
Total Dissolved Solids	39/39	150	1490	--	NA	--	No

µg/L = Micrograms per liter.

-- = Not applicable.

⁽¹⁾ Statistical summary of analytical results for groundwater samples collected from monitoring wells in 2004.

Table 4. Summary of Chemicals Detected in Groundwater
2003 HydroPunch Borings
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

Chemical	Summary of Soil Analytical Data			Cleanup Level (Human Health Drinking Water) (ug/L)	Exceeds Applicable Cleanup Level (Yes/No?)
	Number of Samples Detected/ Number of Samples Analyzed	Minimum Detected Concentration (ug/L)	Maximum Detected Concentration (ug/L)		
Total Petroleum Hydrocarbons (TPH)					
TPH Fuel Oil (C24-C36) (ug/L)	1/14	720	720	1200	No
TPH Gasoline (C7-C12) (ug/L)	7/14	96	8000	770	Yes
TPH Unknown Diesel Hydrocarbon (ug/L)	4/11	63	430	880	No
VOCs					
1,1,1-Trichloroethane (ug/l)	3/11	0.35	1.7	200	No
1,1,2-Trichloroethane (ug/l)	1/11	4.6	4.6	5	No
2-Butanone (ug/l)	2/11	7.4	7.9	--	No
2-Hexanone (ug/l)	2/11	1	20	--	No
Acetone (ug/l)	1/11	15	15	--	No
Benzene (ug/L)	8/14	0.057	16	1	Yes
Bromodichloromethane (ug/l)	1/11	1.8	1.8	80	No
Chloroform (ug/l)	2/11	0.13	0.14	80	No
Ethylbenzene (ug/L)	7/14	0.17	3.6	300	No
Tetrachloroethene (ug/l)	3/11	0.69	1.1	5	No
Toluene (ug/L)	5/14	0.11	4.9	150	No
Xylenes (m&p-) (ug/l)	6/11	0.31	10	1,750	No
Xylenes (o-) (ug/L)	4/14	0.18	2.5	1,750	No
Xylenes (total) (ug/L)	1/3	2.6	2.6	1,750	No
Metals					
Antimony (ug/L)	4/14	6.3	7.6	6	Yes
Arsenic (ug/L)	1/14	5.1	5.1	10	No
Barium (ug/L)	13/14	10	300	1,000	No
Chromium (ug/L)	2/14	1.2	1.5	50	No
Cobalt (ug/L)	8/14	1.9	15	--	No
Copper (ug/L)	1/14	1	1	1,000	No
Lead (ug/L)	2/14	4.1	4.1	15	No
Molybdenum (ug/L)	4/14	5.6	22	35	No
Nickel (ug/L)	3/14	4.1	8	100	No
Vanadium (ug/L)	3/14	1.2	4.6	--	No
Zinc (ug/L)	2/14	10	10	5,000	No

µg/L = Micrograms per liter.

-- = Not applicable.

Cleanup levels selected from the following:

Presidio-wide Cleanup Level Document (PWCLD; EKI, 2002), 7-6.

Federal and California MCL on <http://www.dhs.ca.gov/ps/ddwem/chemicals/MCL/EPAandDHS.pdf>

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Table 5. Cleanup Levels for Soil
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

Chemical ^a	Cleanup Level in FEPZ/Ecological Buffer		Cleanup Level Outside FEPZ/Ecological Buffer	
	Zone ^(c)		Zone ^(d)	
	(mg/kg)	(b)	(mg/kg)	
Total Petroleum Hydrocarbons (TPH)				
TPH (as gasoline)	11.6	2	100	1b
TPH (as diesel)	115	1,2	115	1b
TPH (as fuel oil)	144	1,2	160	1b
PAHs				
Acenaphthene	40	1a	2,700	1b
Acenaphthylene	40	1a	--	
Anthracene	40	1a	308	1b
Benzo(a)anthracene	0.43	1b	0.43	1b
Benzo(a)pyrene	0.04	1b	0.04	1b
Benzo(b)fluoranthene	0.43	1b	0.43	1b
Benzo(g,h,i)perylene	40	1a	620	1b
Benzo(k)fluoranthene	0.43	1b	0.43	1b
Chrysene	4.3	1b	4.3	1b
Dibenzo(a,h)anthracene	0.078	1a	0.078	1a
Fluoranthene	40	1a	316	1b
Fluorene	40	1a	60	1b
Indeno(1,2,3-c,d)pyrene	0.27	1a	0.27	1a
Naphthalene	9	1b	9	1b
Phenanthrene	40	1a	86	1b
Pyrene	40	1a	241	1b
VOCs				
Acetone	0.24	1a	0.24	1a
Benzene	0.005	1b	0.005	1b
Bromodichloromethane	0.012	1a	0.012	1a
Bromoform	2.2	1a	2.2	1a
Bromomethane	0.22	1a	0.22	1a
2-Hexanone (MBK)	2.7	3s	2.7	3s
Carbon disulfide	200	1a	200	1a
Carbon tetrachloride	0.012	1a	0.012	1a
Chlorobenzene	1.5	1a	1.5	1a
Dibromochloromethane	0.019	1a	0.019	1a
Chloroethane	0.63	1a	0.63	1a
2-Chloroethyl vinyl ether	--	--	--	--
Chloroform	0.098	1a	0.098	1a
Chloromethane	0.29	1a	0.29	1a
1,1-Dichloroethane	0.2	1a	0.2	1a
1,2-Dichloroethane	0.0045	1a	0.0045	1a
cis-1,2-Dichloroethene	0.19	1a	0.19	1a
trans-1,2-Dichloroethene	0.67	1a	0.67	1a
1,2-Dichloropropane	0.052	1a	0.052	1a
cis-1,3-dichloropropene	0.033	1a	0.033	1a
trans-1,3-dichloropropene	0.033	1a	0.033	1a
Ethylbenzene	13	1b	13	1b
2-Butanone (MEK)	3.8	1a	3.8	1a

Table 5. Cleanup Levels for Soil
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

Chemical ^a	Cleanup Level in		Cleanup Level Outside	
	FEPZ/Ecological Buffer		FEPZ/Ecological Buffer	
	Zone ^(c)		Zone ^(d)	
	(mg/kg)	(b)	(mg/kg)	
Methylene chloride	0.076	1a	0.076	1a
Methyl-tert butyl ether	0.023	1a	0.023	1a
4-Methyl-2-pentanone (MIBK)	2.7	1a	2.7	1a
Styrene	1.5	1a	1.5	1a
1,1,2,2-Tetrachloroethane	0.009	1a	0.009	1a
Tetrachloroethene	0.088	1a	0.088	1a
Toluene	1	1b	1	1b
1,1,1-Trichloroethane	0.17	1	8	1
1,1,2-Trichloroethane	0.033	1a	0.033	1a
Trichloroethene	0.26	1a	0.26	1a
Vinyl acetate	430	1a	430	1a
Vinyl chloride	0.0067	1a	0.0067	1a
Total Xylenes	33	1b	33	1b
Metals				
Aluminum	76,000	4	76,000	4
Antimony	5	1a	29	1a
Arsenic	5.9	1a	5.9	1a
Barium	500	1a	5,000	1a
Beryllium	10	1a	140	1a
Cadmium	1.7	1a	1.7	1a
Calcium	--		--	
Chromium	120	1a	1,200	1a
Cobalt	48	1a	4,000	1a
Copper	120	1a	225	1a
Iron	--		--	
Lead	300	1a	400	1a
Magnesium	--		--	
Manganese	1,800	4	1,800	4
Mercury	1.6	1a	20.0	1a
Molybdenum	300	1a	360	1a
Nickel	71	1a	1,400	1a
Potassium	--	--	--	--
Selenium	1.1	1a	360.00	1a
Silver	2	1a	360	1a
Sodium	--	--	--	--
Thallium	1	1a	5.7	1a
Vanadium	92	1a	650	1a
Zinc	66	1a	22,000	1a

mg/kg = Milligram per kilogram

RWQCB ESL = Regional Water Quality Control Board Environmental Screening Levels

PRG = Preliminary Remediation Goal

**Table 5. Cleanup Levels for Soil
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California**

Chemical ^a	Cleanup Level in	Cleanup Level Outside
	FEPZ/Ecological Buffer	FEPZ/Ecological Buffer
	Zone ^(c) (mg/kg)	Zone ^(d) (mg/kg)
	(b)	

^a Only chemicals that were identified as COCs and/or were included in the confirmation sampling program Area are listed.

^b Cleanup levels selected from the following:

- 1b) Presidio-wide Cleanup Level Document (PWCLD; *EKI, 2002*), 7-5.
- 1a) Presidio-wide Cleanup Level Document (PWCLD; *EKI, 2002*), Tables 7-2.
- 2) Development of Freshwater TPH-diesel and TPH-fuel oil Point of Compliance Concentrations (*BBL, 2004*)
- 3) RWQCB soil ESL (lowest of human toxicity and indoor air impacts) (*RWQCB, 2005*).
- 4) Soil PRG (*USEPA, 2004*).

^c The lowest of residential land use or FEPZ/Ecological buffer zone cleanup levels were selected, unless for metals, the background level was higher, then the background level was selected as the cleanup level.

^d Residential land use cleanup levels were selected, unless for metals, the background level was higher, then the background level was selected as the applicable cleanup level.

(s) Surrogate cleanup level for 2-hexanone is ESL for MIBK

Groundwater (less than 5 feet above groundwater).

-- For chemicals with no cleanup levels, there are no Presidio cleanup levels, RWQCB ESLs, or USEPA PRGs.

Checked _____

Approved _____

**Table 6. Cleanup Levels for Groundwater
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California**

Chemical ^(a)	Cleanup Level Outside of FEPZ/Ecological Buffer Zone (µg/L)	Cleanup Level Inside FEPZ/Ecological Buffer Zone (µg/L)	Source of Cleanup Level ^b
Total Petroleum Hydrocarbons (TPH)			
TPH as gasoline	770	443	Presidio-Wide Cleanup Level Document/TPH POC Concentrations
Metals / Inorganics			
Antimony	6	6	Presidio-Wide Cleanup Level Document Basin Plan
Arsenic	10	10	
Volatile Organic Compounds (VOCs)			
Benzene	1	1	Presidio-Wide Cleanup Level Document
Ethylbenzene	300	300	California MCL
Toluene	150	150	Presidio-Wide Cleanup Level Document
			California MCL/Presidio-Wide Cleanup Level
Xylenes	1,750	318	Document

µg/L

Micrograms per liter.

MCL

Maximum contaminant level.

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Not available - where no level is listed, there are no Presidio cleanup levels or federal or California MCLs for the compound.

^a Only identified groundwater COCs or PCOCs are listed.

^(b) Presidio-wide Cleanup Level Document (PWCLD; *EKI, 2002*), Table 7-6.

Development of Freshwater TPH-diesel and TPH-fuel oil Point of Compliance Concentrations (BBL, 2004)

Federal and California MCL on <http://www.dhs.ca.gov/ps/ddwem/chemicals/MCL/EPAandDHS.pdf>

RWQCB Basin Plan (*RWQCB, 2004*)

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Table 7. Summary of the Evaluation of Corrective Action Alternatives
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

REMEDIAL UNIT	DESCRIPTION OF REMEDIAL UNIT	CORRECTIVE ACTION ALTERNATIVES		
		<u>ALTERNATIVE 1</u> NO ACTION	<u>ALTERNATIVE 2</u> CAPPING, LAND USE CONTROLS, GROUNDWATER MONITORING	<u>ALTERNATIVE 3</u> EXCAVATION AND OFFSITE DISPOSAL OF SOIL, IN SITU APPLICATION OF OXYGEN RELEASE PRODUCT AS NECESSARY, GROUNDWATER MONITORING
EXISTING BUILDING 1063 AREA SOIL AND GROUNDWATER REMEDIAL UNITS A	<u>SOIL AND GROUNDWATER</u> EXTENSIVE AREA OF TPH, PAHs, BTEX, 2- HEXANONE, AND METALS BENEATH HISTORIC BUILDING 1063 BEING RENOVATED TO HOUSE WATER RECYCLING STORAGE TANKS	<u>NOT PROTECTIVE</u>	EFFECTIVE & IMPLEMENTABLE IF RENOVATION IS NOT IMPLEMENTED	EFFECTIVE & IMPLEMENTABLE
DEBRIS FILL UNDER PARKING LOT AREA SOIL REMEDIAL UNIT B	<u>SOIL</u> EXTENSIVE DEBRIS FILL CONTAINING TPH, PAHs AND METALS BENEATH PARKING LOT	TO BE EVALUATED IN FILL SITE 6B REMEDIAL ACTION PLAN	TO BE EVALUATED IN FILL SITE 6B REMEDIAL ACTION PLAN	TO BE EVALUATED IN FILL SITE 6B REMEDIAL ACTION PLAN
EXISTING HISTORIC BUILDING 1040 AREA SOIL REMEDIAL UNIT C	<u>SOIL</u> LIMITED AREA OF TPH EXTENDING BENEATH WESTERN CORNER OF HISTORIC BUILDING 1040 BRICK STRUCTURE THAT HOUSED FORMER LETTERMAN HOSPITAL POWER PLANT	NOT PROTECTIVE	EFFECTIVE & IMPLEMENTABLE	NOT IMPLEMENTABLE; WOULD IMPACT HISTORIC STRUCTURE

BTEX = BENZENE, TOLUENE, ETHYLBENZENE, XYLENES PAHs = POLYCYCLIC AROMATIC HYDROCARBONS TPH = TOTAL PETROLEUM HYDROCARBONS AS GASOLINE, DIESEL, FUEL OIL
VOCs = VOLATILE ORGANIC COMPOUNDS

Table 7. Summary of the Evaluation of Corrective Action Alternatives
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

CORRECTIVE ACTION ALTERNATIVE	EVALUATION CRITERIA							
	EFFECTIVENESS		IMPLEMENTABILITY			RELATIVE COST		
	Site-Specific Applicability	Ability to Achieve RAOs	Constructability	Timeliness	Impacts to Ongoing Operations and Resources	Capital Cost	O&M Cost	Total Cost
ALTERNATIVE 1 NO ACTION	<u>All RUs</u> Takes no action to address COCs above cleanup levels within the three RUs <u>A and C</u> . Would not be applicable for any of the RUs, which contain COCs above cleanup levels that are in contact with the saturated zone and would continue to serve as a potential source of groundwater contamination. In addition, significant portions of these RUs occur beneath buildings and contain volatile compounds. Contaminated soil would not be removed, allowing flammable vapors to potentially migrate into the airspace and utility infrastructures inside the buildings. These vapors may pose a health and safety risk from inhalation by workers/future occupants of the building and from potential ignition sources from equipment and tools used in the building.	<u>All RUs</u> Would not achieve RAOs because it takes no action to (1) address the presence of COCs in soil beneath buildings, which would present a risk to workers/future occupants conducting ongoing and planned operations within the buildings, and (2) address the potential source of contaminants to groundwater. Although the COC concentrations are expected to decrease by natural attenuation, it will take longer for cleanup levels to be achieved.	<u>All RUs</u> Would not involve construction or operation of equipment.	<u>All RUs</u> Could be implemented in the shortest timeframe because it takes no action.	<u>All RUs</u> Would have impacts on the ongoing and planned operations within the buildings. Potential hazards from vapors in unremediated soil beneath the buildings would have to be mitigated. Workers could be exposed to contaminated soil and vapors, requiring 40-hour hazardous materials training and mitigation of exposures. Soil vapor abatement measures would need to be implemented to prevent migration of COCs into the buildings. In addition, it would not take advantage of the opportunity to implement a corrective action alternative <u>prior to or in coordination with</u> during installation of water <u>treatment plant project construction</u> storage tank equipment within Building 1063, after which it would be much more difficult to implement and disruptive to ongoing operations.	NONE Would not require capital expenditures.	NONE Would not require O&M expenditures.	NONE No associated costs.

COCs = chemicals of concern CULs = cleanup levels LUCs = land use controls O&M = operations and maintenance RAOs = Remedial Action Objectives RU = Remedial Unit

Table 7. Summary of the Evaluation of Corrective Action Alternatives
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

CORRECTIVE ACTION ALTERNATIVE	EVALUATION CRITERIA							
	EFFECTIVENESS		IMPLEMENTABILITY			RELATIVE COST		
	Site-Specific Applicability	Ability to Achieve RAOs	Constructability	Timeliness	Impacts to Ongoing Operations and Resources	Capital Cost	O&M Cost	Total Cost
ALTERNATIVE 2 CAPPING, LAND USE CONTROLS, GROUNDWATER MONITORING	<u>Soil & Groundwater RUs A</u> Would be applicable for soil and groundwater beneath Building 1063 if the water tank renovation is not implemented. The building foundation and adjacent area would be inspected to determine the need for ‘capping improvements’ (e.g., sealing the flooring and any conduits to the subsurface, monitoring indoor air quality) to prevent future indoor workers from exposure to volatile COCs that may intrude into the building airspace. Improvements would be implemented as necessary. The cap would be maintained and LUCs would be implemented to prevent alternate reuses over a period of 30 years. Groundwater monitoring of petroleum-related COCs, <u>arsenic, and redox parameters and metals</u> in <u>two</u> existing <u>downgradient</u> wells <u>shown in Table 9</u> would be performed until petroleum-related COCs <u>and</u> <u>arsenic</u> are below cleanup levels for four consecutive sampling rounds. <u>Soil RU-B</u> Would be applicable for soil beneath the parking lot. Improvements to existing pavement (e.g., patching, resealing, repaving) and extension of pavement over limited areas not currently covered would be implemented as necessary. The cap would be maintained and LUCs would be implemented to prevent alternate reuses over a period of 30 years. Groundwater monitoring would not be applicable because petroleum-related COCs were not detected above CULs in groundwater collocated with this RU.	<u>All RUs</u> Would achieve RAOs to the extent practicable based on planned reuse (preserving existing historic structures <u>and</u> <u>current reuse of the parking area</u> in a cost-effective manner) because it would eliminate exposure pathways to COCs above CULs and establish LUCs to prevent alternate reuses. Would significantly reduce risks to workers/future occupants conducting ongoing and planned operations within the buildings. Although it would not include removal or treatment of contaminated soil or groundwater, capping to prevent exposures and reduce surface water infiltration, and natural attenuation would eventually serve to reduce the mass of contaminants in shallow soil that may potentially continue to affect groundwater quality.	<u>All RUs</u> Would consist of standard construction activities for indoor air sampling, inspecting the integrity of foundations and structures, and improving and maintaining caps over these RUs. The equipment, materials, and labor to conduct these activities are readily available. No special permitting, construction, or maintenance of permanent structures or utilities would be required.	<u>All RUs</u> Could be implemented within a short timeframe.	<u>All RUs</u> Would have minimal impacts on the current <u>ongoing and planned</u> operations within the buildings because capping improvements on existing foundations and pavement and long term maintenance could be readily performed. Would not require installation of any permanent equipment that would remain in place. Would prevent impacts to historic resources (Buildings 1063 and 1040) while maintaining their foundational integrity and eliminating potential exposure pathways to COCs beneath the buildings, and prevent potential impacts to cultural resources because no intrusive activities would be conducted. <u>However, would impact planned operations because it would leave contaminated soils beneath Building 1063 (RU A) in vicinity of water treatment plant project construction where excavation is planned. During excavation, workers could be exposed to contaminated soil, requiring they receive 40-hour hazardous materials training. Soil vapor abatement measures would need to be implemented during excavation to prevent accumulation of COC vapors within the building.</u>	<u>LOW TO MODERATE</u> \$34,000 – \$299,000 \$50,000 – \$330,000 Would require <u>moderate</u> low capital expenditures of approximately <u>\$299,000 for RUs-A, and low capital expenditures of approximately \$34,000 for RU-C, \$115,000 (RUs-A); \$330,000 (RU-B); \$50,000 (RU-C).</u> Capital costs would include those for indoor air sampling, surveying the integrity of foundations and structures, and maintaining and/or improving impervious caps over these RUs. Administrative aspects of documenting land use controls due to residual contamination would have low relative costs.	<u>LOW TO HIGH</u> \$20,000 – \$400,000 <u>MODERATE</u> \$39,000 – \$206,000 Would require <u>high</u> moderate O&M expenditures of approximately <u>\$400,000 for RUs-A, and low O&M expenditures of approximately \$20,000 for RU-C, \$206,000 (RUs-A); \$116,000 (RU-B); \$39,000 (RU-C).</u> O&M costs would include those for maintaining the caps and land use controls for a period of 30 years (and conducting groundwater monitoring for RUs-A only <u>until monitoring demonstrates COCs are below cleanup levels</u>).	<u>LOW TO HIGH</u> \$54,000 – \$699,000 <u>MODERATE</u> \$89,000 – \$446,000 Would have a <u>high</u> total cost of approximately <u>\$699,000 for RUs-A, and low total cost of approximately \$54,000 for RU-C, low-to-moderate total cost of approximately \$321,000 (RUs-A); \$446,000 (RU-B); \$89,000 (RU-C).</u>

COCs = chemicals of concern CULs = cleanup levels LUCs = land use controls O&M = operations and maintenance RAOs = Remedial Action Objectives RU = Remedial Unit

Table 7. Summary of the Evaluation of Corrective Action Alternatives
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

CORRECTIVE ACTION ALTERNATIVE	EVALUATION CRITERIA							
	EFFECTIVENESS		IMPLEMENTABILITY			RELATIVE COST		
	Site-Specific Applicability	Ability to Achieve RAOs	Constructability	Timeliness	Impacts to Ongoing Operations and Resources	Capital Cost	O&M Cost	Total Cost
ALTERNATIVE 3 EXCAVATION AND OFFSITE DISPOSAL OF SOIL, APPLICATION OF IN SITU OXYGEN RELEASE PRODUCT AS NECESSARY, GROUNDWATER MONITORING	Soil & Groundwater RUs A & Soil RU-B Would be applicable for soil and groundwater beneath Building 1063 and soil beneath the parking lot. Contaminated soil would be removed from beneath the building to the extent practicable based on structural limitations (between building walls and footings that remain in place). It is anticipated the majority of the contaminated soil within the footprint of the building would be removed to a depth of 8 feet bgs, extending 1 foot beneath the water table and allowing for significant source removal. Excavation would be similarly implemented beneath the parking lot (excavation to Bay Mud). Would also provide the opportunity to apply an oxygen release product within the excavation after soil has been removed to provide long term remediation of any residual contamination in the capillary fringe and in groundwater. Groundwater monitoring of petroleum-related COCs, <u>arsenic</u>, <u>and redox parameters in and metals in two</u> existing downgradient wells <u>shown in Table 9</u> would be performed for RUs-A only until petroleum-related COCs and arsenic are below cleanup levels for four consecutive sampling rounds.	Soil & Groundwater RUs A & Soil RU-B Would achieve RAOs because it would remediate soil containing COCs above cleanup levels in soil beneath Building 1063 to the extent practicable, and entirely from beneath the parking lot. Implementation would significantly reduce risks to workers/future occupants conducting ongoing and planned operations within the building, and would also serve to reduce the mass of contaminants in shallow soil that may potentially continue to affect groundwater quality in RUs-A.	Soil & Groundwater RUs A & Soil RU-B Would consist of standard construction activities for soil excavation, dewatering, soil staging and sampling, placement of oxygen release product and offsite transportation and disposal <u>of soil</u>. The equipment, materials, and labor to conduct these activities are readily available. No special permitting, construction, or maintenance of permanent structures or utilities would be required.	Soil & Groundwater RUs A & Soil RU-B Could be implemented and completed within a moderate timeframe corresponding with the <u>water treatment plant project</u> renovation schedule.	Soil & Groundwater RUs A & Soil RU-B Would have minimal impacts on the ongoing and planned operations within the Building 1063 because soil excavation would not require installation of any equipment that would remain in place or require monitoring and maintenance, <u>and could be conducted prior to or in coordination with water treatment plant project construction</u>. Would minimize impacts to the historical structure by only excavating areas that can be accessed as part of the water tank installation. During excavation, workers could be exposed to contaminated soil, requiring they receive 40-hour hazardous materials training. Soil vapor abatement measures would need to be implemented during excavation to prevent accumulation of COC vapors within the building. <u>Soil RU-C</u> Would have impacts on Building 1040 because it is a historic structure designated for preservation, and excavation could not be conducted without damaging the structure.	<u>HIGH</u> <u>\$536,000</u> <u>Would require high capital expenditures of approximately \$536,000 for RUs-A only.</u> MODERATE TO HIGH \$346,900 — \$1,663,000 <u>Would require moderate to high capital expenditures of approximately \$346,900 (RUs-A); \$1,663,000 (RU-B).</u> Capital costs would include those for excavation, confirmation sampling and analysis, <u>placement of ORC</u>, and offsite disposal of soil. Removal of roof support columns and the concrete slab required to perform the excavation within Building 1063 <u>could be conducted prior to or in coordination with water treatment plant project construction</u> would be conducted as part of ongoing and planned site operations. Administrative aspects of documenting land use controls <u>for groundwater until monitoring demonstrates COCs are below cleanup levels due to residual contamination (where access is structurally limited)</u> would have a low relative cost.	<u>MODERATE</u> <u>\$170,000</u> LOW <u>\$180,000</u> Would require <u>moderate</u> low O&M expenditures of approximately \$170,000 <u>\$180,000</u> for RUs-A only. O&M costs would include those for groundwater monitoring <u>and maintaining a land use control on groundwater until monitoring demonstrates COCs are below cleanup levels</u>.	<u>HIGH</u> <u>\$706,000</u> MODERATE TO HIGH \$526,900 — \$1,663,000 Would have a <u>moderate</u> high <u>to high</u> total approximate cost of \$706,000 <u>\$526,900 for (RUs-A only); \$1,663,000 (RU-B).</u>

COCs = chemicals of concern CULs = cleanup levels LUCs = land use controls O&M = operations and maintenance RAOs = Remedial Action Objectives RU = Remedial Unit

Checked _____ Approved _____

Table 8. Summary of Corrective Action Alternatives Selection
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

SOIL & GROUNDWATER REMEDIAL UNITS A—EXTENSIVE AREA OF TPH, VOCs BENEATH HISTORIC BUILDING 1063 BEING RENOVATED TO HOUSE WATER RECYCLING TANK								
CORRECTIVE ACTION ALTERNATIVE	EVALUATION CRITERIA							
	EFFECTIVENESS		IMPLEMENTABILITY			RELATIVE COST		
	SITE-SPECIFIC APPLICABILITY	ABILITY TO ACHIEVE REMEDIAL ACTION OBJECTIVES (RAOs)	CONSTRUCTABILITY	TIMELINESS	IMPACTS TO ONGOING OPERATIONS AND RESOURCES	CAPITAL COST	OPERATIONS & MAINTENANCE COST	TOTAL COST
<u>ALTERNATIVE 1</u> NO ACTION	NOT APPLICABLE; WOULD NOT ADDRESS CONTAMINANTS ABOVE CLEANUP LEVELS IN CONTACT WITH GROUNDWATER THAT POSE A RISK TO WORKERS.	WOULD NOT ACHIEVE RAOs IN THE SHORT TERM.	WOULD NOT INVOLVE CONSTRUCTION.	EASY TO IMPLEMENT.	IMPACTS ON OPERATIONS IN BUILDING DUE TO WORKER EXPOSURE.	NONE	NONE	NONE
<u>ALTERNATIVE 2</u> CAPPING, LAND USE CONTROLS, GROUNDWATER MONITORING	APPLICABLE IF REUSE CHANGES; WOULD MITIGATE EXPOSURES, BUT THE MAJORITY OF SOIL AND GROUNDWATER CAN BE ACCESSED FOR REMOVAL AND TREATMENT OF RESIDUAL CONTAMINANTS VIA ORC OR EQUIVALENT TECHNOLOGY WITHIN EXCAVATION.	WOULD ACHIEVE RAOs TO EXTENT PRACTICABLE BASED ON PLANNED REUSE IN A COST-EFFECTIVE MANNER, BUT WOULD NOT REMEDIATE OR ELIMINATE CONTAMINANTS.	STANDARD CONSTRUCTION ACTIVITIES FOR CAPPING IMPROVEMENTS OF BUILDING FOUNDATION AND ADJACENT AREAS USING READILY AVAILABLE RESOURCES.	EASY TO IMPLEMENT WITHIN A SHORT TIMEFRAME.	MINIMAL IMPACTS ON <u>CURRENT</u> OPERATIONS AND WOULD PREVENT IMPACTS TO HISTORIC AND CULTURAL RESOURCES. <u>IMPACT ON PLANNED OPERATIONS: LEAVES CONTAMINATED SOILS BENEATH BUILDING FOUNDATION IN VICINITY OF WATER TREATMENT PLANT PROJECT CONSTRUCTION.</u>	<u>MODERATE</u> LOW (\$ 299,000 115,000) CAPPING IMPROVEMENTS, LAND USE CONTROLS.	HIGH <u>MODERATE</u> (\$ 400,000 206,000 OVER 30 YEARS) MAINTAINING CAP, LAND USE CONTROLS, GROUNDWATER MONITORING.	LOW TO MODERATE <u>HIGH</u> (\$ 699,000 321,000)
RECOMMENDED CORRECTIVE ACTION ALTERNATIVE								
<u>ALTERNATIVE 3</u> EXCAVATION AND OFFSITE DISPOSAL OF SOIL, APPLICATION OF IN SITU OXYGEN RELEASE PRODUCT AS NECESSARY, GROUNDWATER MONITORING	APPLICABLE; WOULD PERMANENTLY REMOVE THE MAJORITY OF CONTAMINATION AND ELIMINATE EXPOSURES WHILE REMEDIAL UNIT IS ACCESSIBLE DURING RENOVATION.	WOULD ACHIEVE RAOs IN THE SHORTEST TIMEFRAME AND TO THE GREATEST DEGREE BY PERMANENTLY REMOVING THE MAJORITY OF CONTAMINATION WITH LIMITED DISTURBANCE OF PLANNED REUSE WHILE PRESERVING HISTORIC STRUCTURE.	STANDARD CONSTRUCTION ACTIVITIES FOR EXCAVATION AND OFFSITE DISPOSAL USING READILY AVAILABLE RESOURCES.	MODERATE LEVEL OF EFFORT TO IMPLEMENT WITHIN A SHORT TIME FRAME COINCIDING WITH RENOVATION WORK.	SOME IMPACTS ON OPERATIONS DURING EXCAVATION; WOULD PREVENT IMPACTS TO HISTORIC RESOURCES.	MODERATE TO HIGH (\$ 536,000 346,900) EXCAVATION, PLACEMENT OF ORC OR EQUIVALENT TECHNOLOGY, OFFSITE DISPOSAL OF SOIL, GROUNDWATER MONITORING.	MODERATE <u>LOW</u> (\$ 170,000 180,000 OVER 3 YEARS) GROUNDWATER MONITORING.	MODERATE TO-HIGH (\$ 706,000 526,900)

Table 8. Summary of Corrective Action Alternatives Selection
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

SOIL REMEDIAL UNIT C — LIMITED AREA OF TPH, BENEATH HISTORIC BUILDING 1040; BRICK STRUCTURE THAT HOUSED FORMER LETTERMAN HOSPITAL POWER PLANT								
CORRECTIVE ACTION ALTERNATIVE	EVALUATION CRITERIA							
	EFFECTIVENESS		IMPLEMENTABILITY			RELATIVE COST		
	SITE-SPECIFIC APPLICABILITY	ABILITY TO ACHIEVE REMEDIAL ACTION OBJECTIVES (RAOS)	CONSTRUCTABILITY	TIMELINESS	IMPACTS TO ONGOING OPERATIONS AND RESOURCES	CAPITAL COST	OPERATIONS & MAINTENANCE COST	TOTAL COST
ALTERNATIVE 1 NO ACTION	NOT APPLICABLE; WOULD NOT ADDRESS CONTAMINANTS ABOVE CLEANUP LEVELS IN CONTACT WITH GROUNDWATER THAT POSE A RISK TO WORKERS.	WOULD NOT ACHIEVE RAOS IN THE SHORT TERM.	WOULD NOT INVOLVE CONSTRUCTION.	EASY TO IMPLEMENT.	IMPACTS ON OPERATIONS IN BUILDING DUE TO WORKER EXPOSURE.	NONE	NONE	NONE
RECOMMENDED CORRECTIVE ACTION ALTERNATIVE								
ALTERNATIVE 2 CAPPING, LAND USE CONTROLS	APPLICABLE; WOULD MITIGATE EXPOSURES AND BE CONSISTENT WITH FUTURE REUSE AND PRESERVE HISTORIC STRUCTURE.	WOULD ACHIEVE RAOS TO EXTENT PRACTICABLE BASED ON PLANNED REUSE BY PRESERVING HISTORIC STRUCTURE AND MITIGATING EXPOSURES IN A COST-EFFECTIVE MANNER.	STANDARD CONSTRUCTION ACTIVITIES FOR CAPPING IMPROVEMENTS OF EXISTING BUILDING FOUNDATION AND ADJACENT AREA USING READILY AVAILABLE RESOURCES.	EASY TO IMPLEMENT WITHIN A SHORT TIMEFRAME.	NO IMPACTS ON OPERATIONS OR HISTORIC RESOURCES.	LOW (\$ 34,000 50,000) CAPPING IMPROVEMENTS, LAND USE CONTROLS.	LOW (\$ 20,000 39,000 OVER 30 YEARS) MAINTAINING CAP, LAND USE CONTROLS.	LOW (\$ 54,000 89,000)
ALTERNATIVE 3 EXCAVATION AND OFFSITE DISPOSAL OF SOIL	NOT APPLICABLE; BUILDING DESIGNATED FOR PRESERVATION. EXCAVATION WITHIN FOOTPRINT OF UNREINFORCED HISTORIC BRICK STRUCTURE WITH 4-FOOT THICK FOUNDATION COULD NOT BE CONDUCTED WITHOUT SIGNIFICANT IMPACTS TO STRUCTURAL INTEGRITY.	WOULD NOT ACHIEVE RAOS IN INACCESSIBLE AREAS AND WOULD NOT ACHIEVE PLANNED REUSE TO PRESERVE HISTORIC STRUCTURE.	SPECIALIZED CONSTRUCTION ACTIVITIES FOR STRUCTURAL SUPPORT DURING EXCAVATION; STANDARD OFFSITE DISPOSAL OF SOIL.	COULD NOT BE IMPLEMENTED.	SIGNIFICANT IMPACTS ON OPERATIONS AND HISTORIC RESOURCES.	--	--	--

Checked_____
Approved_____

**Table 9. Groundwater Monitoring Program
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California**

Well ID	Water Bearing Zone	Objectives	Analytes (1)	Monitoring Frequency	Monitoring Duration
RU-A Monitoring Wells					
1065PZ1A	Shallow Zone	Monitor in the vicinity of RU-A for petroleum-related COCs	TPHg/BTEX	TPHg/BTEX: Quarterly for 1 year, then semi-annually	TPHg/BTEX: Until four consecutive rounds of TPHg & BTEX concentrations below cleanup levels
1065PZ1B	Intermediate Zone				
1065MW101A	Shallow Zone				
1065MW102A	Shallow Zone				
		Monitor for arsenic & redox parameters	Arsenic & Redox Parameters	Arsenic & Redox Parameters: Quarterly for 1 year, then annually	Arsenic & Redox Parameters: Until concentrations of arsenic below cleanup levels
1065MW9A	Shallow Zone	Monitor groundwater levels		Groundwater Level Monitoring: Each monitoring event	Groundwater Level Monitoring: Until site-wide groundwater monitoring program ends
Wells Monitored for Arsenic & Redox Parameters Only					
1065PZ2A	Shallow Zone	Monitor for arsenic & redox parameters	Arsenic & Redox Parameters	Arsenic & Redox Parameters: Quarterly for 1 year, then annually	Arsenic & Redox Parameters: Until concentrations of arsenic below cleanup levels
1065PZ3A	Shallow Zone				
1065PZ4A	Shallow Zone				
1065PZ5AR	Shallow Zone				
1065PZ6A	Shallow Zone	Monitor groundwater levels		Groundwater Level Monitoring: Each monitoring event	Groundwater Level Monitoring: Until site-wide groundwater monitoring program ends
1065MW10A	Shallow Zone				
Wells Used for Groundwater Level Monitoring Only					
1027MW01	Shallow Zone	Monitor groundwater levels	Not applicable	Quarterly for 1 year (TPHg/BTEX / Arsenic & Redox Parameter monitoring frequency) Then semi-annually (TPHg/BTEX monitoring frequency until concentrations below cleanup levels) Then annually (Arsenic & Redox Parameters monitoring frequency until arsenic concentrations below cleanup levels)	Until site-wide groundwater monitoring program ends
1027MW01	Shallow Zone				
1027MW03	Shallow Zone				
1065PZ7A	Shallow Zone				
1065MW11A	Shallow Zone				
1047MW101A	Shallow Zone				
1065PZ2B	Intermediate Zone				
1065PZ3B	Intermediate Zone				
1065PZ4B	Intermediate Zone				
1065PZ5B	Intermediate Zone				
1065PZ6B	Intermediate Zone				
1065PZ7B	Intermediate Zone				
1065MW9B	Intermediate Zone				
1065MW10B	Intermediate Zone				
1065MW11B	Intermediate Zone				

Notes

All wells will be abandoned at the end of the site-wide groundwater monitoring program.

(1) TPHg analyzed by EPA Test Method 8015 modified / BTEX analyzed by EPA Test Method 8021B / As, Al, Fe, Mn analyzed by EPA Test Method 6010

"Redox parameters" are other metals analyzed under EPA Test Method 6010 with As (Al, Fe, Mn) and field measurement of dissolved oxygen (DO) & oxidation-reduction potential (ORP)

Checked_____

Approved_____

PLATES



EXPLANATION

- BUILDING 231 / 207 STUDY AREA
- FILL SITE 6A
- FILL SITE 6B INVESTIGATION AREAS
- SPECIAL STATUS ECOLOGICAL SPECIES ZONE - GENERAL LOCATION OF PROPOSED TENNESSEE HOLLOW RIPARIAN CORRIDOR
- FRESHWATER ECOLOGICAL PROTECTION ZONE

NOTE: This plate shows proposed investigation areas for Fill Site 6B. The limits of Fill Site 6B will be further defined in a Remedial Action Plan for that site.



0 1000 2000
SCALE IN FEET

DRAWN:	PH	PROJECT NO:	4089030004 00112
ENGINEER:		SCALE:	1"=1000'
CHECKED:		DATE:	
APPROVED:		REVISED DATE:	08/06



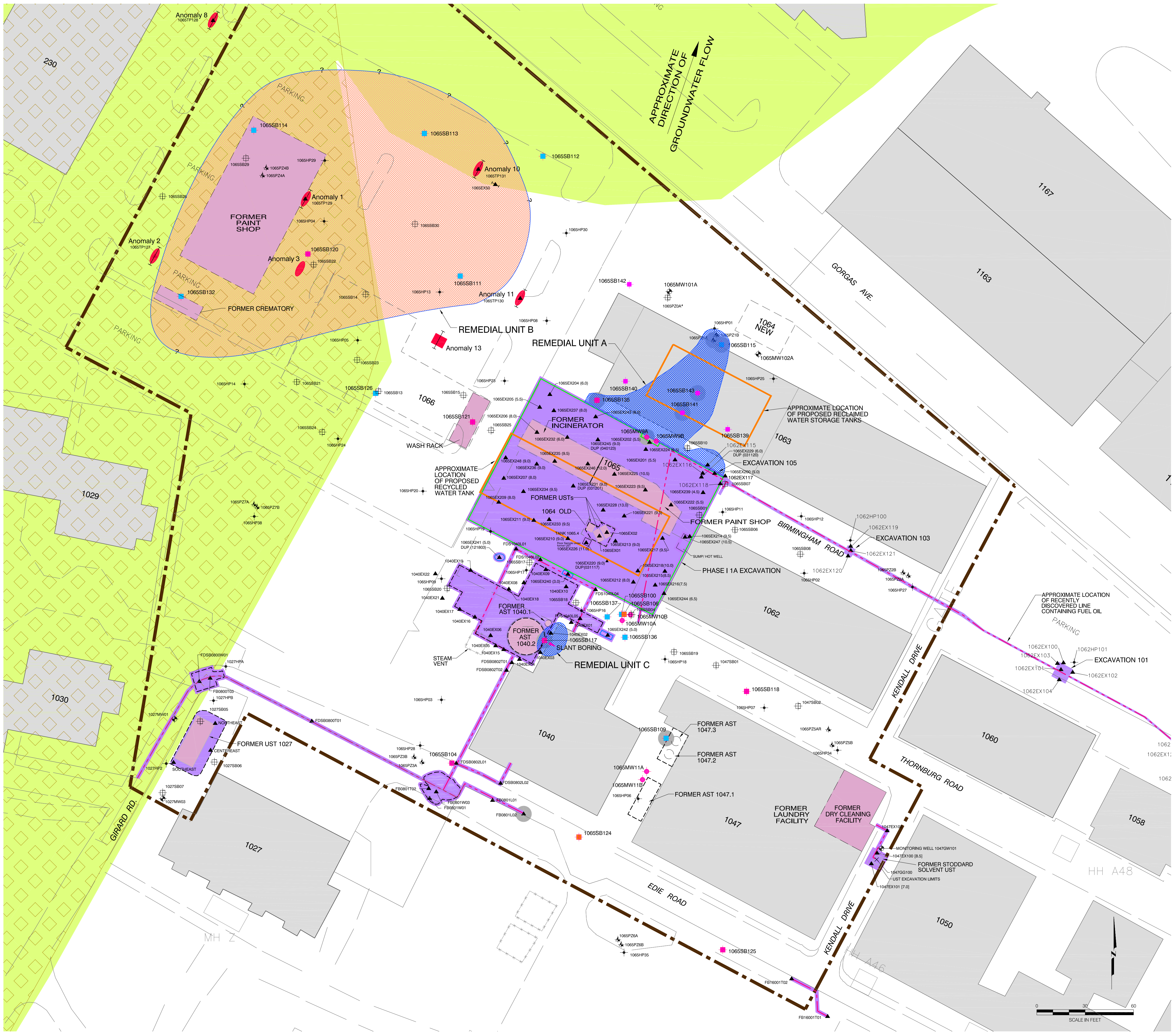
Presidio of San Francisco
San Francisco, California

Site Location Map
Corrective Action Plan
Building 1065 Area

PLATE:

1

4089030004041.DWG 1.0
20060317.1019



- EXPLANATION**
- MONITORING WELL
 - PIEZOMETER
 - HYDROPUNCH
 - SOIL BORING
 - BUILDING NUMBER
 - EXISTING STRUCTURE
 - STRUCTURE PREVIOUSLY REMOVED
 - LOCATION OF FORMER FUEL DISTRIBUTION PIPELINE
 - FENCE
 - FORMER EXCAVATION BOUNDARY
 - BUILDING 1065 AREA SITE BOUNDARY
 - POTENTIAL SOURCE AREAS
 - MACTEC 10-FOOT SOIL BORING - SOIL SAMPLES ONLY
 - MACTEC 25-FOOT SOIL BORING - SOIL AND GROUNDWATER SAMPLES
 - MACTEC 40-FOOT SOIL BORING - SOIL AND GROUNDWATER SAMPLES
 - MACTEC GROUNDWATER MONITORING WELL PAIR (SHALLOW AND INTERMEDIATE GROUNDWATER ZONES)
 - TEST PIT LOCATION
 - TEST PIT OR EXCAVATION SAMPLE LOCATION
 - GRAB GROUNDWATER SAMPLE LOCATION
 - GEOPHYSICAL ANOMALY INDICATIVE OF BURIED METAL
 - POT HOLE EXCAVATION LIMITS
 - AREAS OF PREVIOUS CORRECTIVE ACTION
 - NO PIEZOMETER INSTALLED AT 1065PZ0A; ONLY SOIL SAMPLES COLLECTED AND ANALYZED
 - FRESHWATER ECOLOGICAL PROTECTION ZONE
 - BUFFER ZONE ECOLOGICAL CLEANUP LEVEL
 - PHASE I INTERIM ACTION EXCAVATION
 - REMEDIAL UNIT FOR CAP
 - REMEDIAL UNIT TO BE ADDRESSED BY REMEDIAL ACTION PLAN FOR FILL SITE 6B

NOTE:
PREVIOUS SAMPLE LOCATIONS AND RESULTS THAT FELL WITHIN BOUNDARIES OF CORRECTIVE ACTION AREA (HORIZONTAL AND VERTICAL) AND WERE REMOVED BY EXCAVATION ARE NOT SHOWN.

NO.	DATE	REVISIONS	BY	CHK	DRAWN: PH	PROJECT NO: 4089030004 00177
					CHECKED:	SCALE:
					DATE: 6/27/05	APPROVED:
					DATE: 6/27/05	DATE: 6/27/05



CORRECTIVE ACTION PLAN

**BUILDING 1065 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA**

Soil Remedial Units

DRAWING	14
SHEET:	OF
REVISION NUMBER:	0
DATE:	08/06

4089030004 00177.dwg 4/13

APPENDIX A

RESPONSIVENESS SUMMARY — *COMMENTS AND RESPONSES* *(FINAL VERSION ONLY)*

APPENDIX A – RESPONSIVENESS SUMMARY
Response to California Regional Water Quality Control Board Comments on
Draft Corrective Action Plan (CAP) for Building 1065 Area,
Presidio Trust, San Francisco, California

The following presents Presidio Trust (Trust) responses to California Regional Water Quality Control Board Comments (RWQCB) on *Draft Corrective Action Plan, Building 1065 Area, Presidio of San Francisco, California*, (CAP) dated June 29, 2005. The comments were presented in a November 14, 2005 letter from the RWQCB to Mr. Craig Cooper of the Trust. The RWQCB comments are reproduced below followed by Trust responses. The text of the CAP has been revised such that a corrective action will not be selected for Remedial Unit (RU)-B; evaluation and selection of a remedial alternative for this RU will be addressed in the Remedial Action Plan (RAP) which addresses Fill Site 6B (FS 6B).

In addition to the changes specified below, the text of the Draft CAP and estimated costs associated with the remedial options presented in the Draft CAP have been revised to include conclusions from a recent study to evaluate arsenic in groundwater and its relationship to petroleum hydrocarbons, soil types, and groundwater chemistry at the Building 1065 Area and two neighboring CAP sites, the Commissary/PX Area and Building 207/231 Area (*MACTEC, 2006 in preparation*). To incorporate recommendations from the arsenic study, the Trust modified the groundwater monitoring program proposed in the Draft CAP.

Comment 1. Please check the tables provided in the Draft CAP for completeness. Examples of omissions include:

- a. Undefined endnote #1 listed on Table 3
- b. Table 7 – Existing Building 1063 Area; Alternative 1 box contains no description. Should it read “not protective”?
- c. Missing data qualifiers for the analytical tables provided in Appendix B, Table B-2 (e.g., NJ, U--).

Response 1:

- a. The following footnote 1 was added to Table 1 in the final CAP: “(1) Statistical summary of analytical results for groundwater samples collected from monitoring wells in 2004.”
- b. Table 7 was revised to include NOT PROTECTIVE for Alternative 1.
- c. Qualifier definitions are provided for Table B-2 as well as all of the tables in Appendix D.

Comment 2. The nature and extent of Remedial Unit B shallow soil contamination is uncertain (see Drawing 14 of the Draft CAP). The Draft CAP recommends a remedial alternative which requires knowledge of the lateral extent of contamination. However, it is our understanding that additional site characterization of Fill Site 6B will adequately delineate the lateral extent of soil and groundwater contamination around Remedial Unit B. Therefore, we will comment on Remedial Unit B remedial alternative after evaluating the Fill Site 6B report.

Response 2: The final CAP was revised such that a corrective action will not be selected for Remedial Unit (RU)-B; evaluation and selection of a remedial alternative for this RU will be addressed in the Remedial Action Plan (RAP) which addresses Fill Site 6B (FS 6B). At appropriate locations throughout the final version of the document, the CAP text

concerning RU-B explains that because the areal extent of chemicals of concern (COCs) in shallow soil at RU-B have not been fully delineated, a final corrective action for that RU cannot be selected. The Final CAP text further clarifies that: (a) soil contamination in the vicinity of RU-B will be investigated by the Trust as part of its upcoming remedial investigation of FS 6B; and (b) evaluation and selection of a remedial alternative for the RU-B area will be documented in the RAP which addresses FS 6B. In order to have a clear transition from draft to final versions of the CAP, a description of RU-B remains in the final version of the CAP with the appropriate caveats concerning uncertainty regarding the areal extent of soil contamination. In Section 4.2 of the Final CAP [Corrective Alternatives Considered], text was edited to state that due to uncertainty concerning the areal extent of soil contamination, no corrective action alternatives were considered for RU-B. Accordingly, discussions concerning RU-B in Sections 4.2 through 4.4 were removed from the CAP. In Sections 4.5 and 5.0 of the CAP and the Executive Summary, statements were made that no corrective action has been selected for RU-B and further investigation and evaluation of remedial alternatives will be addressed in the upcoming RAP for FS6B. Table 1 in Appendix F has been modified to remove the cost analysis for RU-B, Tables F-3 and F-4 have been removed, and Table F-5 has been renamed F-3.

Comment 3. In the executive summary (page xiv), it states that “Contamination is not expected to extend below 8 to 8.5 feet bgs, the estimated top of the Bay Mud aquitard in this area.” We would like to see the data to support this statement.

Response 3: Borings drilled in the vicinity of RU-A show that Bay Mud deposits were first encountered at depths ranging from approximately 5 to 8 feet below ground surface (bgs) (deeper where there are underground utilities and the native soil is disturbed – approximately 10 feet bgs in Well 1065MW9B) and is up to 7 feet thick in the vicinity of Boring 1065SB139. Plate 5 of the Draft CAP contains cross sections that show the extent of the Bay Mud unit at the site. Logs of borings and wells drilled in the vicinity of RU-A during investigation programs conducted in 2002 (MACTEC, 2003) and 2003 (MACTEC, 2004) are attached to this responsiveness summary. In this area, Bay Mud comprises fat clay, clay with sand, sandy clay, and organic soil. Based on the high percentage of clay and relative thickness of this unit, the Bay Mud is expected to retard the vertical migration of contaminants. Limited soil samples have been collected from depths below 8 feet bgs in this area, because soils below that depth are saturated. However, deeper samples collected from 1065MW9A show non-detect concentrations of petroleum hydrocarbons in the 9.5-foot bgs samples compared to samples collected from 3.5 and 6 feet bgs which contain detectable concentrations of TPH and BTEX. A summary of TPH and BTEX results for soil samples collected from well boring 1065MW9A are summarized below.

Analyte	Sample Depth (ft)	3.5		6		9.5	
	Units	Value	Qual	Value	Qual	Value	Qual
TPH Gasoline (C7-C12)	Mg/kg	5,100		ND(59)		ND(1.2)	
TPH Fuel Oil (C24-C36)	Mg/kg	1,100		16		ND(12)	
TPH Unknown Diesel Hydrocarbon	Mg/kg	190		13		ND(6.2)	
Benzene	Mg/kg	0.126		0.025		ND(0.005)	
Ethylbenzene	Mg/kg	0.0863	/J	ND(0.005)		ND(0.005)	
Toluene	Mg/kg	0.0884	/J	ND(0.005)		ND(0.005)	
Xylenes (m&p-)	Mg/kg	NT		0.00263	/J	ND(0.005)	
Xylenes (total)	Mg/kg	0.316		NT		NT	

Note: Concentrations shown in bold typeface exceed applicable cleanup levels.

The Bay Mud serves as the boundary between the shallow and intermediate groundwater zones at the site. The intermediate groundwater zone shows an upward vertical gradient in this area. Sampling of shallow and intermediate zone wells in the vicinity of RU-A has shown that contaminants were either not detected or were detected at lower concentrations in the intermediate groundwater zone than in the lower groundwater zone. For example, benzene was detected at concentrations up to 33 µg/L in shallow zone well 1065MW9A, but it was not detected in intermediate zone well 1065MW9B.

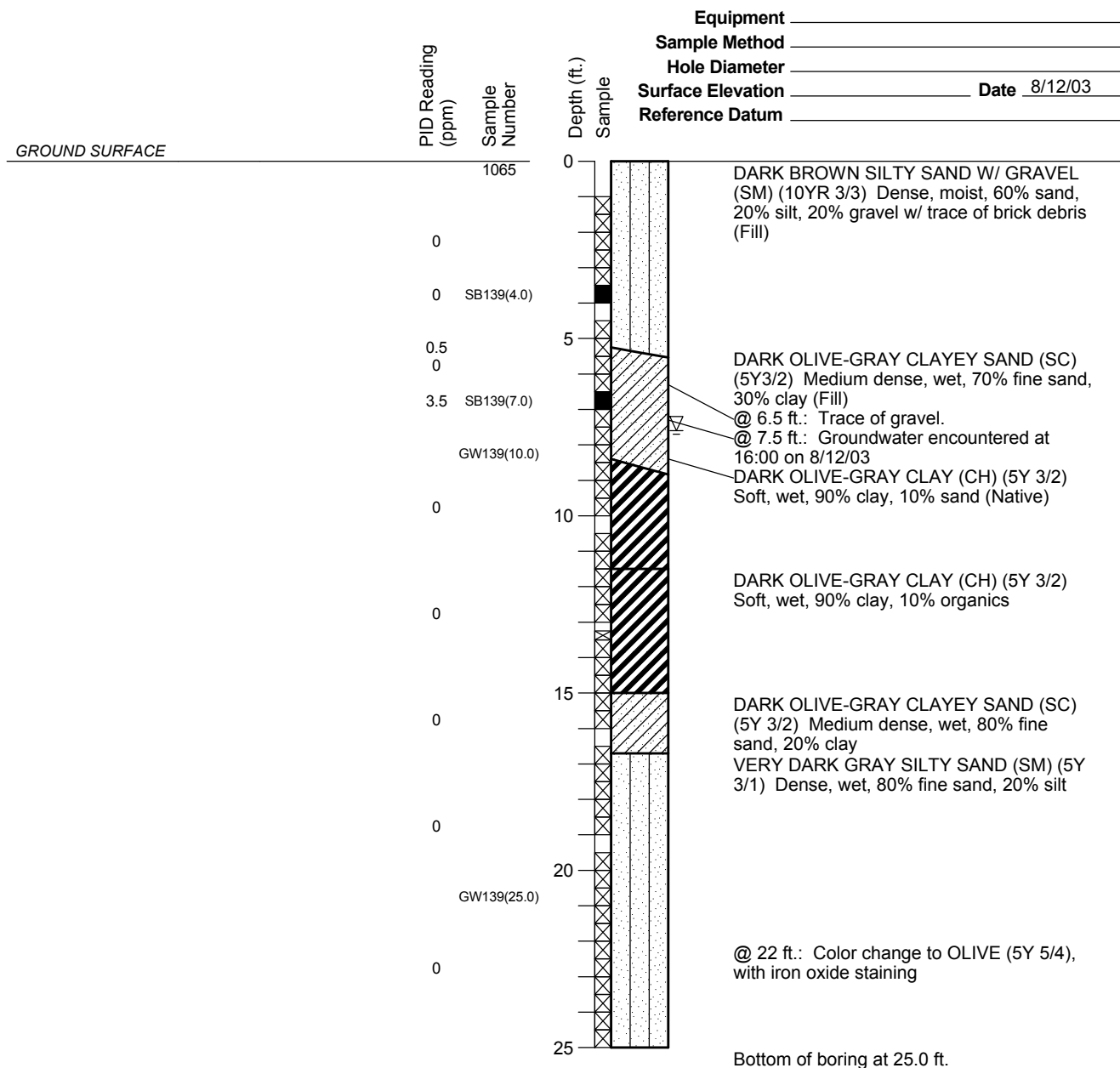
Text in the executive summary and in Section 2.5.3 [Conceptual Model of Nature and Extent of Contamination] will include a discussion of the nature and thickness of the Bay Mud aquitard and its observed and expected effect on retarding the vertical migration of contaminants.

REFERENCES CITED

MACTEC Engineering and Consulting Inc. (MACTEC), 2003. *Interim Data Report, Building 1065 Area, Presidio of San Francisco, California*. February.

_____, 2004. *Investigation Report, Building 1063 and Building 1062 Hot Well/Sump, Building 1065 Corrective Action Plan Area, Presidio of San Francisco, California*. January.

MACTEC_3A 40890121.GPJ GEOL.GDT 12/14/05



PLATE



MACTEC

Log of Boring 1065SB139

Building 1065 Area
Presidio of San Francisco
San Francisco, California

A-2

DRAWN

JOB NUMBER

4089030006 00121

CHECKED

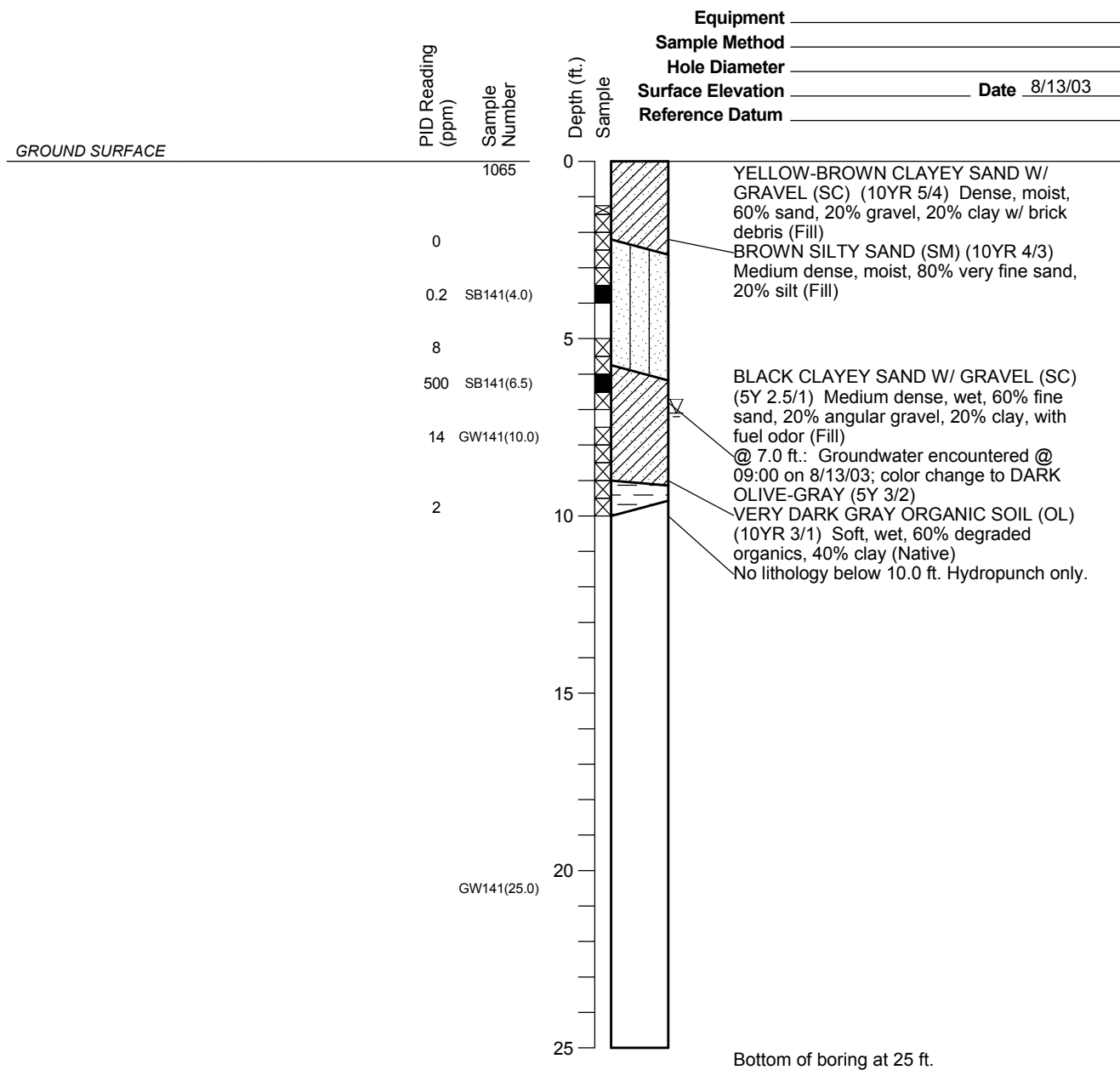
CHK'D DATE

12/05

APPROVED

APPR'V'D DATE

MACTEC_3A 40890121.GPJ GEOL.GDT 12/14/05



PLATE



MACTEC

Log of Boring 1065SB141

Building 1065 Area
Presidio of San Francisco
San Francisco, California

A-4

DRAWN

JOB NUMBER

4089030006 00121

CHECKED

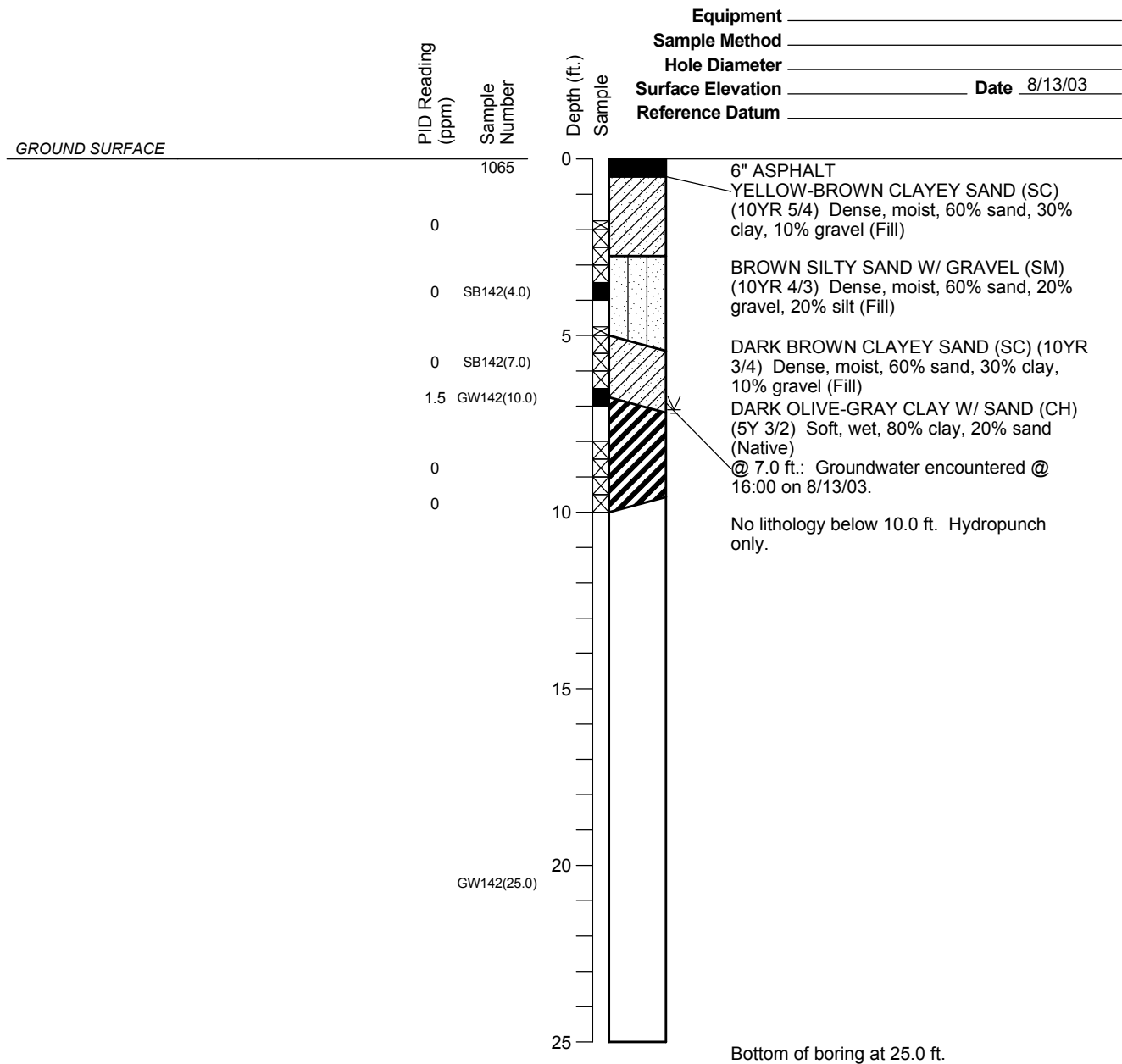
CHK'D DATE

12/05

APPROVED

APPR'D DATE

MACTEC_3A 40890121.GPJ GEOL.GDT 12/14/05



PLATE



MACTEC

Log of Boring 1065SB142

Building 1065 Area
Presidio of San Francisco
San Francisco, California

A-5

DRAWN

JOB NUMBER

4089030006 00121

CHECKED

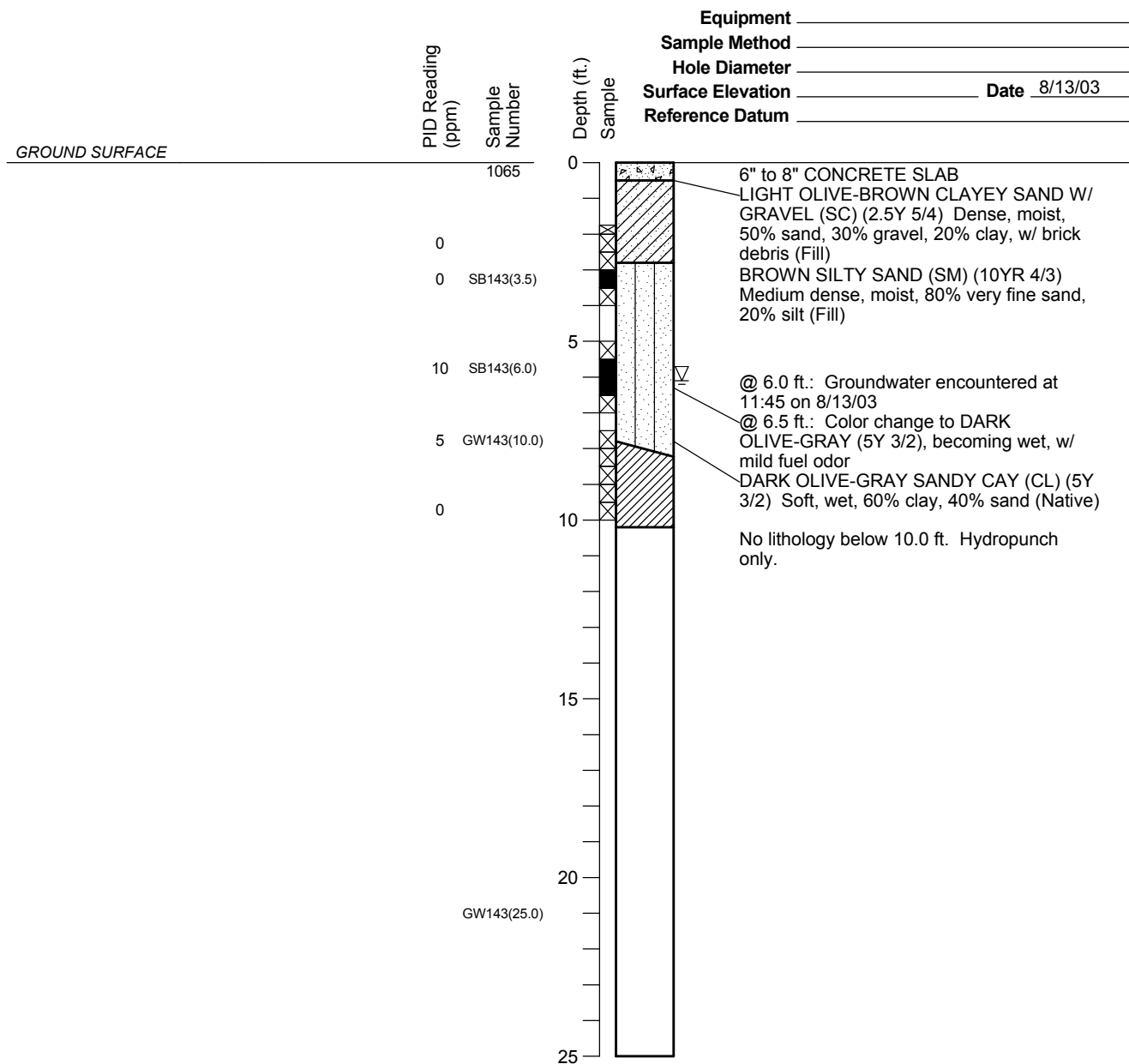
CHK'D DATE

12/05

APPROVED

APPR'V'D DATE

MACTEC_3A 40890121.GPJ GEOL.GDT 12/14/05



PLATE



MACTEC

Log of Boring 1065SB143

Building 1065 Area
Presidio of San Francisco
San Francisco, California

A-6

DRAWN

JOB NUMBER

4089030006 00121

CHECKED

CHK'D DATE

12/05

APPROVED

APPR'V'D DATE

CHRISTY
BOX

GROUND SURFACE

CONCRETE
GROUT, 0 to 0.5
ft.

VOLCLAY
GROUT, 0.5 to 2
ft.

2 IN. DIA.
SCHEDULE 40
BLANK CASING, 0
to 3 ft.

0/30 TRANSITION
SAND, 2.0 to 2.5
ft.

LONESTAR 2/12
SANDPACK, 2.5 to
15 ft.

2 IN. DIA.
SLOTTED .010 IN.
SCREEN, 3.0 to
13.0 ft.

8 IN. DIA.
BOREHOLE, 0 to
15.5 ft.

2 IN. DIA.
SCHEDULE 40
PVC BLANK SILT
TRAP, 13 to 13.3
ft.

BOTTOM WELL
CAP at 13.3 ft.

HOLE CLEANED
OUT to 15.5 ft.

BOTTOM OF
BOREHOLE, 15.5
ft.

Blows/Foot

PID Reading
(ppm)

Sample
Number

Depth (ft.)
Sample

Equipment B61 Hollow Stem Auger

Sample Method

Hole Diameter 8 inch

Surface Elevation

Date 9/30/02

Reference Datum

1065SB

0

1000

9A(3.5)

150

30

9A(6)

10

5

9A(9.5)

0

9A(9.5)

0

9A(9.5)

0

9A(9.5)

0

9A(9.5)

0

9A(9.5)

0

9A(9.5)

0

9A(9.5)

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9A(9.5)

0

9A(9.5)

0

9A(9.5)

0

9A(9.5)

0

9A(9.5)

4 in. Asphalt
BROWN GRAVELLY CLAY (CL) (10YR
5/3), firm, moist, 60% clay, 30% gravel (SS,
Brick, Chert), 10% sand [FILL]

BLACK SILTY SAND (SM) (5Y 2.5/1), loose
moist to wet, 60% fine sand, 40% silt [FILL]

Groundwater level at 4.5 ft. at 0930 on
9/30/02.

OLIVE-BROWN SILT WITH SAND (ML)
(2.5Y 4/4), firm, moist, 80% silt, 20% fine
sand, with iron oxide staining [FILL]

DARK OLIVE-GRAY SILT (ML) (5Y 3/2),
soft, wet, 60% silt, 30% clay, 10% sand
[FILL]

DARK OLIVE-GRAY CLAY (CH) (5Y 3/2),
soft, wet, 50% clay, 30% silt, 20% very fine
sand [Disturbed Native]

DARK GRAY CLAY (CH) (5Y 4/1), soft, wet,
90% clay, 10% silt, with trace organics and
grass [Native]

Bottom of boring at 15.5 ft.

* Blows/foot converted to STP.

BORING_WELL_HARDINGESE 54382.GPJ GEOL.GDT 2/19/03



MACTEC

Well Construction Details and
Log of Boring 1065MW9A

PLATE

Building 1065 Area
Presidio of San Francisco, California

B34

DRAWN
TAC

JOB NUMBER
54382 00142

APPROVED
MJH

DATE
2/03

REVISED DATE

Equipment B61 Hollow Stem Auger

Sample Method

Hole Diameter 8 inch and 14 inch

Surface Elevation

Date 9/30/02

Reference Datum

CHRISTY
BOX

GROUND SURFACE

TOP OF CASING
at 0.5 ft. below
ground level2 IN. DIA.
SCHEDULE 40
BLANK CASING,
0.5 to 26 ft.BENTONITE
CEMENT SEAL, 0
to 15 ft.14 IN. DIA.
BOREHOLE, 0 to
17.5 ft.BENTONITE
CEMENT SEAL, 0
to 17.5 ft.12 IN. DIA.
CONDUCTOR
CASING, 1 to 19.5
ft.8 IN. DIA.
BOREHOLE, 0 to
32 ft.VOLCLAY
GROUT, 15 to 25
ft.0/30 TRANSITION
SAND, 25 to 25.5
ft.LONESTAR 2/12
SANDPACK, 25.5
to 32 ft.2 IN. DIA.
SLOTTED 010 IN.
SCREEN, 26 to 32
ft.BOTTOM WELL
CAP at 32 ft.HOLE CLEANED
OUT to 32 ft.
BOTTOM OF
BOREHOLE, 32 ft.

Blows/foot

PID Reading
(ppm)Sample
Number

1065SB

19

0

10

0

13

0

13

0

15

0

43

0

8

0

N/A

0

Depth (ft.)
Sample

0

5

10

15

20

25

30

4 IN. ASPHALT

DARK OLIVE-GRAY SILTY SAND (SM) (5Y
3/2), loose, moist to wet, 80% sand, 20%
silt. [FILL]OLIVE-BROWN CLAY WITH SAND (CL)
(2.5Y 4/3), firm, moist, 60% clay, 20% silt,
20% sand, with iron oxide mottling. [FILL]

@ 5 ft.: SILTY SAND (SM) lense [FILL]

OLIVE-BROWN CLAY WITH SAND (CL)
(2.5Y 4/3), firm, moist, 60% clay, 20% silt,
20% sand, with iron oxide mottling.
[Disturbed Native]BLACK ORGANIC SOIL (OL) (10YR 2/1),
soft, moist, 80% organics, 20% clay/fines.
[NATIVE]VERY DARK GRAY CLAYEY SAND (SC)
(5Y 3/1), loose, wet, 70-90% sand, 10-30%
clayVERY DARK GRAY SAND (SP) (5Y 3/1),
medium dense, wet, 90% fine sand, 10% siltVERY DARK GRAY CLAY (CH) (5Y 3/1),
soft, wet, 100% clayOLIVE-BROWN SILT WITH SAND (ML)
(2.5Y 4/3), firm, moist, 80% silt, 20% very
fine sand, with iron oxide laminationsOLIVE-BROWN SILTY SAND (SM) (2.5Y
4/3), dense, wet, 80% sand, 20% siltSTRONG BROWN SILT (ML) (7.5YR 4/6),
hard, moist, 90% silt, 10% fine sandDARK OLIVE-GRAY SILTY SAND (SM) (5Y
3/2), loose, wet, 80% fine sand, 20% silt,
trace of gravel, occasional inclusion of clay,
with mild petroleum odor@ 28 ft.: Color change to olive-brown (2.5Y
4/3), becoming dense

Bottom of boring at 32 ft.

BORING_WELL_HARDINGESE 54382.GPJ GEOL.GDT 2/19/03

* Blows/foot converted to STP.



MACTEC

Well Construction Details and
Log of Boring 1065MW9B

PLATE

Building 1065 Area
Presidio of San Francisco, California

B35

DRAWN
TACJOB NUMBER
54382 00142APPROVED
MJHDATE
2/03

REVISED DATE

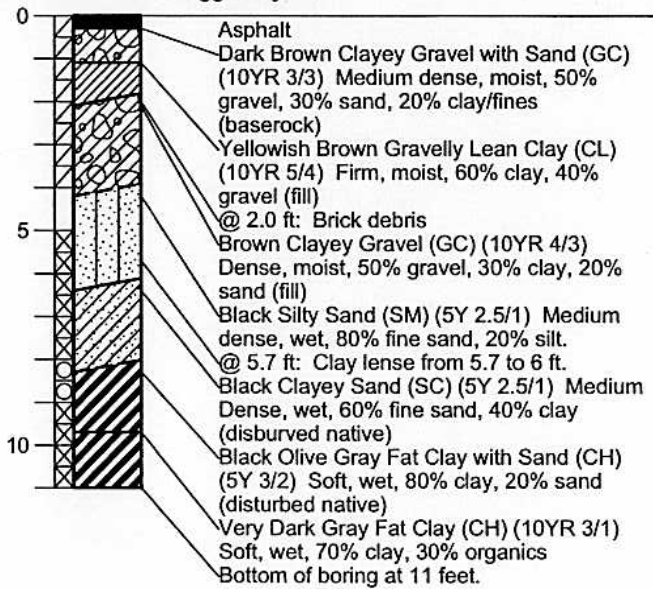
Top of PVC Casing
Elev. 13.06 ft.

Equipment 8 in. HSA
Sample Method 2 in Split Barrel
Hole Diameter 8 in
Surface Elevation 13.47 ft. Date 7/30/04
Reference Datum _____
Logged By AHH

GROUND SURFACE

BENTONITE SLURRY SEAL: 1 to 3.5 ft.
8 in. DIA BOREHOLE: 0 to 11 ft.
2 in. DIA. SCHEDULE 40 PVC CASING: 0.5 to 4.5 ft.
MONTEREY 2/12 AND #30 SAND PACK: 3.5 to 10 ft.
2 in DIA. slotted pipe (0.010 in.): 4.5 to 9.5 ft.
BOTTOM WELL CAP: 10 ft.

Blows/Foot	Recovery (inches)	PID Reading (ppm)
		0
		ND
		ND
4	6	1.5
6	6	
8	6	
2	6	1
2	6	
1	0	
1	0	
1	4	ND
1	6	
2	6	ND
4	6	



BORING_WELL_MACTEC_57255_PRESIDIO.GPJ GEOL.GDT 4/22/05



DRAWN WJF JOB NUMBER 4089030006 00221

Well Construction Details and Log of Boring 1065MW101A

Presidio Building 1065
Building 1065 Cap Area
Presidio of San Francisco, California

CHECKED MAY 10/04 CHCK'D DATE 4/05

APPROVED APPROV'D DATE

PLATE

2

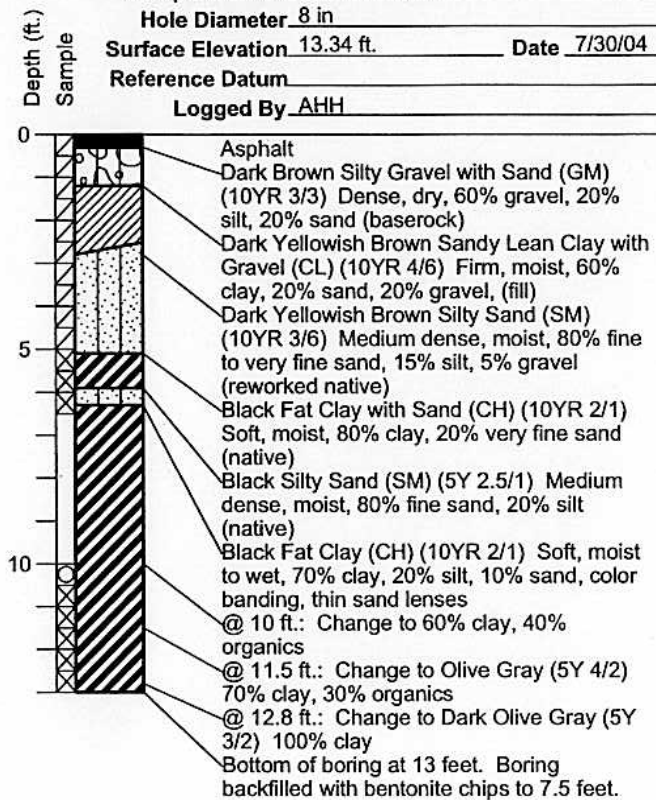
Top of PVC Casing
Elev. 12.83 ft.

Equipment 8 in. HSA
Sample Method 2in Split Barrel
Hole Diameter 8 in
Surface Elevation 13.34 ft. Date 7/30/04
Reference Datum _____
Logged By AHH

GROUND SURFACE

8 in. DIA.
BOREHOLE: 0 to
13 ft.
BENTONITE
SLURRY SEAL: 1
to 3.5 ft.
2 in. DIA.
SCHEDULE 40
PVC CASING: 0.5
to 4.5 ft.
MONTEREY 2/12
AND #30 SAND
PACK: 3.5 to 7.5
ft.
2 in. DIA. slotted
pipe (0.10 in.): 4.5
to 7.5 ft.
BOTTOM WELL
CAP: 7.5 ft.
Hole backfilled with
bentonite chips
from 13 to 7.5 ft.

Blows/Foot	Recovery (inches)	PID Reading (ppm)
		ND
		ND
5	0	
6	6	ND
10	6	ND
3	6	
3	6	
4	6	ND
1	6	
2	6	
3	6	ND



BORING_WELL_MACTEC_57255_PRESIDIO.GPJ GEOL.GDT 4/22/05



DRAWN
WJF

JOB NUMBER
4089030006 00221

Well Construction Details and Log of Boring 1065MW102A

Presidio Building 1065
Building 1065 Cap Area
Presidio of San Francisco, California

CHECKED

CHCK'D DATE

4/05

APPROVED

APPR'VD DATE

PLATE

3

APPENDIX B

GROUNDWATER MONITORING DATA

Table B-5. Laboratory Qualifiers

The following data validation qualifiers for analytical data generated beginning in the second quarter of 2001⁽¹⁾:

U	The analyte was analyzed for, but was not detected above, the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
J+	The analyte was positively identified; the associated numerical value is biased high due to a high surrogate recovery and should be considered an approximate concentration of the analyte in the sample.
J-	The analyte was positively identified; the associated numerical value is biased low due to a low surrogate recovery and should be considered an approximate concentration of the analyte in the sample.
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

The following are laboratory supplied validation comments generated beginning in the second quarter of 2001⁽¹⁾:

B	Analyte is found in the associated blank as well as in the sample.
C	Presence confirmed, but confirmation concentration differed by more than a factor of two.
H	Heavier hydrocarbons contributed to the quantitation.
HT-04	This sample was analyzed beyond the EPA recommended holding time. The results may still be useful for their intended purpose.
L	Lighter hydrocarbons contributed to the quantitation.
Y	Sample exhibits a fuel pattern, which does not resemble standard.
Z	Sample exhibits unknown single peak or peaks.

Analytical data reported prior to the second quarter of 2001 have used the same data qualifiers described above, but have also used the validation qualifiers and comments Q, Rd, DR, D, B, G, P, d, j, k, z. Descriptions of these previously used validation qualifiers and comments are provided in the quarterly monitoring report corresponding to the sampling date shown in the analytical summary tables.

The following is a table of data validation qualifiers and comments used by Montgomery Watson for their previous Presidio groundwater monitoring work⁽¹⁾.

Data Validation Qualifiers:

J – Qualified as estimated

U – Qualified as not detected

R – Qualified as rejected

Table B-5. Laboratory Qualifiers

Data Validation Comments:

- 6. Qualified as negatively biased due to surrogate recoveries below the established acceptance limits.
- 9. Qualified as negatively biased due to MS/MSD recoveries below the established acceptance limits.
- 12. Qualified as negatively biased due to LCS recoveries below the established acceptance limits.
- 14. Qualified as positively biased due to calibration nonconformances.
- 18. Qualified as negatively biased due to sample receipt nonconformances.
- 25. Qualified due to chromatographic pattern of the sample does not match the calibration pattern.
- 29. Qualified due to holding times exceeded.
- 32. Qualified data explained further in the report associated with the sampling event.

Excerpted from Table 11 of *Treadwell and Rollo, 2005*

APPENDIX D

DATA FROM PREVIOUS CORRECTIVE ACTIONS

Appendix D

List of Tables

Table D1.	Summary of Results for Soil Samples, UST 1027
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Table D5.	Summary of Results for Soil Samples, Building 1047 Water Storage Tanks 1047.1, 1047.2, and 1047.3
Table D6.	Summary of Results for Groundwater Samples, Building 1047 Water Storage Tanks 1047.1, 1047.2, and 1047.3
Table D7.	Summary of Results for Groundwater Samples, ASTs 1040.1 and 1040.2
Table D8.	Summary of Results for Soil Samples, ASTs 1040.1 and 1040.2
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Table D16.	Summary of Results for Final Confirmation Soil Samples, FDS on Birmingham Road
Table D17.	Summary of Results for Groundwater Samples, FDS on Birmingham Road
<u>Table D18.</u>	<u>Abbreviations, Laboratory Qualifiers and Comments</u>

Table D-18. Abbreviations, Laboratory Qualifiers and Comments

The following data validation qualifiers for analytical data generated beginning in the second quarter of 2001⁽¹⁾:

U	The analyte was analyzed for, but was not detected above, the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
J+	The analyte was positively identified; the associated numerical value is biased high due to a high surrogate recovery and should be considered an approximate concentration of the analyte in the sample.
J-	The analyte was positively identified; the associated numerical value is biased low due to a low surrogate recovery and should be considered an approximate concentration of the analyte in the sample.
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

The following are laboratory supplied validation comments generated beginning in the second quarter of 2001⁽¹⁾:

B	Analyte is found in the associated blank as well as in the sample.
C	Presence confirmed, but confirmation concentration differed by more than a factor of two.
H	Heavier hydrocarbons contributed to the quantitation.
HT-04	This sample was analyzed beyond the EPA recommended holding time. The results may still be useful for their intended purpose.
L	Lighter hydrocarbons contributed to the quantitation.
Y	Sample exhibits a fuel pattern, which does not resemble standard.
Z	Sample exhibits unknown single peak or peaks.

Analytical data reported prior to the second quarter of 2001 have used the same data qualifiers described above, but have also used the validation qualifiers and comments Q, Rd, DR, D, B, G, P, d, j, k, z. Descriptions of these previously used validation qualifiers and comments are provided in the quarterly monitoring report corresponding to the sampling date shown in the analytical summary tables.

The following is a table of data validation qualifiers and comments used by Montgomery Watson for their previous Presidio groundwater monitoring work⁽¹⁾.

Data Validation Qualifiers:

J – Qualified as estimated

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R – Qualified as rejected

Table D-18. Abbreviations, Laboratory Qualifiers and Comments

Data Validation Comments:

- 6. Qualified as negatively biased due to surrogate recoveries below the established acceptance limits.
- 9. Qualified as negatively biased due to MS/MSD recoveries below the established acceptance limits.
- 12. Qualified as negatively biased due to LCS recoveries below the established acceptance limits.
- 14. Qualified as positively biased due to calibration nonconformances.
- 18. Qualified as negatively biased due to sample receipt nonconformances.
- 25. Qualified due to chromatographic pattern of the sample does not match the calibration pattern.
- 29. Qualified due to holding times exceeded.
- 32. Qualified data explained further in the report associated with the sampling event.

Excerpted from Table 11 of *Treadwell and Rollo, 2005*

Abbreviations

mg/kg	milligrams per kilogram
TPH	total petroleum hydrocarbons
mg/l	milligrams per liter
µg/l	micrograms per liter
SGCU	silica gel cleanup
VOC	volatile organic compound

APPENDIX F

COST ESTIMATES AND ASSUMPTIONS FOR CORRECTIVE ACTION ALTERNATIVES

Appendix F
Summary of Estimated Capital, Annual, and Total Costs for
Corrective Action Alternatives
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

Remedial Unit	Recommended Corrective Action Alternative	Corrective Action Alternative	CAPITAL COSTS (2006 Dollars)	Present Worth of Estimated ANNUAL COSTS (2006 Dollars)	Present Worth of Estimated TOTAL COSTS (2006 Dollars)	Cost Breakdown
Soil and Groundwater Remedial Units A (Bldg 1063 Area)		1) No Action for Soil or Groundwater	\$ --	\$ --	\$ --	No costs
		2) Capping, Land Use Controls, Groundwater Monitoring	\$ 299,000	\$ 400,000	\$ 699,000	Table F-1
	X	3) Excavation, Offsite Dispose of Soil, Groundwater Monitoring	\$ 536,000	\$ 170,000	\$ 706,000	Table F-2
Soil Remedial Unit C (Bldg 1040 Area)		1) No Action for Soil	\$ --	\$ --	\$ --	No costs
	X	2) Capping, Land Use Controls	\$ 34,000	\$ 20,000	\$ 54,000	Table F-3

Checked_____

Approved_____

Appendix F
Cost Estimate Assumptions and Unit Rate Derivations
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

Majority of unit costs and assumptions are updated to **2006 dollars** based on those presented in the Revised Main Installation Sites Feasibility Study, Presidio of San Francisco, California (EKI, 2003) unless otherwise noted. Since July 2000 when the initial FS cost estimates were developed, costs have increased **by a factor of 1.19 as of March 2006** based on the Construction Cost Index calculated monthly and published in the Engineering News Record (ENR) (www.enr.com).

Task Description	Unit	Unit Cost	Source	Comments
EXCAVATION ALTERNATIVES – Capital Costs				
Excavate Soil and Backfill				
Mobilize contractor equipment and supplies to site	ls	\$ 10,000	Presidio Trust past bid experience at similar area	All Building 1065 Area CAP site work for this task will be conducted with share of cost allocated as follows: 100% to SRU A; No excavation activities at SRU C.
Excavate soil (3 cy bucket) and place in end-dump truck	cy	\$ 4.2	Main Installation Sites FS (EKI, 2003) updated for 2006	Excavation quantities assume no sloping for SRU A within existing building footprint.
Dewatering during excavation	ls	\$ 25,000	Presidio Trust past bid experience at similar area (Fill Site 6A)	Applicable to SRU A.
Application of oxygen release product	lb	\$ 10.00	Building 1065 Interim Action Work Plan, Attachment A ORC Calculation Sheet (MACTEC, 2004b)	Dry broadcast of oxygen release product and mixing with soil in excavation bottom at a rate of 1.0 lb/sf based on input parameters to "Regenesis Design Software for Excavation Applications" worksheet (e.g., excavation and groundwater plume size, COC concentrations, hydrogeologic conditions). For SRU A, application over 100% of excavation bottom.
Import, place, compact backfill	cy	\$ 23	Landfills 8 & 10 FS (EKI, 2005)	For SRU A, backfill 2/3 of volume removed to accommodate siting of water storage tanks partially below grade within Building 1063.
Disposal Characterization				
Collect soil profile samples for disposal	ea	\$ 30.9	Main Installation Sites FS (EKI, 2003) updated for 2006	One profile sample will be collected for every 500 cubic yards of soil.
Analyze soil profile samples for disposal (Title 22 Metals [EPA Method 6010/7740], Soluble Threshold Limit Concentration [Waste Extraction Test])	ea	\$ 185	Curtis & Tompkins, Ltd. Analytical Laboratory, June 2005 Analytical Testing Quotation	One profile sample will be analyzed for every 500 cubic yards of soil.
Transport and dispose of soil				For SRU A excavated soil will meet acceptance criteria for disposal as follows: 40% - Class III landfill; 50% - Class II landfill; 10% - Class I non-RCRA landfill.
Unit weight conversion	1 cy =	1.8 tons	Presidio Trust past experience (Building 1065 Interim Action Work Plan; MACTEC, 2004)	

Appendix F
Cost Estimate Assumptions and Unit Rate Derivations
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

Task Description	Unit	Unit Cost	Source	Comments
Class III landfill disposal	ton	\$ 23	Presidio Trust past bid experience at similar areas (includes transportation, generator & disposal fees)	For SRU A 40% of excavated soil will meet acceptance criteria for Class III landfill disposal.
Class II non-RCRA hazardous landfill disposal	ton	\$ 35	Presidio Trust past bid experience at similar areas (includes transportation, generator & disposal fees)	For SRU A 50% of excavated soil will meet acceptance criteria for Class II landfill disposal.
Class I non-RCRA hazardous landfill disposal	ton	\$ 70	Presidio Trust past bid experience at similar areas (includes transportation, generator & disposal fees)	For SRU A 10% of excavated soil will meet acceptance criteria for Class I non-RCRA landfill disposal.
Site Preparation and Restoration			Main Installation Sites FS (EKI, 2003) updated for 2005	See "Capping/Capping Improvements" below. SRU A: Building 1063 foundation would already be removed to provide access to soils within building footprint; portion of SRU A outside building footprint that would not be excavated would have capping improvements as under Capping Alternative.
CAPPING ALTERNATIVES -- Capital Costs				
Capping/Capping Improvements				
Mobilize contractor equipment and supplies to site	ls	\$ 10,000	Presidio Trust past bid experience at similar area	All Building 1065 Area CAP site work for this task will be conducted with share of cost allocated as follows: 90% to SRU A; 10% to SRU C.
Asphalt cap/capping improvements of paved areas				5% of existing paved areas that are weathered/damaged require capping improvements (asphalt/curb removal and replacement).
Sawcut asphalt	ft	\$ 2.6	Main Installation Sites FS (EKI, 2003) updated for 2006	
Demolish asphalt, dispose/recycle off-site	sf	\$ 1.2	Main Installation Sites FS (EKI, 2003) updated for 2006	
Repave with aggregate base and asphalt	sf	\$ 2.7	Main Installation Sites FS (EKI, 2003) updated for 2006	
Indoor building inspection/capping improvements				
Inspection, indoor air quality monitoring, seal fractures/conduits	ls	\$ 5,000	Presidio Trust past bid experience	All Building 1065 Area CAP site work for this task will be conducted with share of cost allocated as follows: 90% to SRU A; 10% to SRU C.
ALL ALTERNATIVES				
Capital Costs				

Appendix F
Cost Estimate Assumptions and Unit Rate Derivations
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

Task Description	Unit	Unit Cost	Source	Comments
Implement Land Use Control				<u>Excavation Alternatives:</u> LUCs for co-located Soil and Groundwater RUs where excavation is implemented are assumed to be lifted when cleanup levels are met in groundwater after 5 years of monitoring (SRU A). <u>Capping Alternatives:</u> LUCs for RUs where capping is implemented are assumed to be permanently maintained, and are costed for a period of 30 years per USEPA's A Guide to Developing and Documenting Cost Estimates During the Feasibility Study (USEPA, 2000) (SRUs A and C).
Site-Specific Addendum to LUCMRR	ls	\$ 10,000	Presidio Trust experience; February 28, 2005 email from C Cooper of Presidio Trust	All Building 1065 Area CAP site work for this task will be conducted with share of cost allocated as follows: 90% to SRU A; 10% to SRU C.
Share of Costs for LUCMRR	ls	\$ 5,000	Presidio Trust experience; February 28, 2005 email from C Cooper of Presidio Trust	All Building 1065 Area CAP site work for this task will be conducted with share of cost allocated as follows: 90% to SRU A; 10% to SRU C.
Add Site-Specific LUC to Trust GIS System	ls	\$ 500	Presidio Trust experience; February 28, 2005 email from C Cooper of Presidio Trust	All Building 1065 Area CAP site work for this task will be conducted with share of cost allocated as follows: 90% to SRU A; 10% to SRU C.
Design and Construction Management Services				
Engineering				
Perform general planning activities	ls	\$ 11,900	Main Installation Sites FS (EKI, 2003) updated for 2006	All Building 1065 Area CAP site work for this task will be conducted with share of cost allocated as follows: 90% to SRU A; 10% to SRU C.
Prepare remedial design plans and specifications	ls	\$ 44,625	Main Installation Sites FS (EKI, 2003) updated for 2006	Assumes 5 design sheets will be prepared for Building 1065 Area CAP site work at an updated cost of \$8,925 per sheet. This task will be conducted with share of cost allocated as follows: 90% to SRU A; 10% to SRU C.
Prepare remedial design reports	ls	\$ 44,625	Main Installation Sites FS (EKI, 2003) updated for 2006	All Building 1065 Area CAP site work for this task will be conducted with share of cost allocated as follows: 90% to SRU A; 10% to SRU C.
Construction Observation				
Provide resident engineer	wk	\$ 5,950	Main Installation Sites FS (EKI, 2003) updated for 2006	
Provide vehicles and equipment	wk	\$ 1,547	Main Installation Sites FS (EKI, 2003) updated for 2006	
Conduct geotechnical and compaction testing	wk	\$ 3,868	Main Installation Sites FS (EKI, 2003) updated for 2006	
Collect soil confirmation sample	ea	\$ 30.9	Main Installation Sites FS (EKI, 2003) updated for 2006	Confirmation sampling includes collection of 1 sample per 625 square feet from excavation bottom; 1 sample per 25 linear feet of sidewall. QA/QC samples will be collected and analyzed at a rate of 10%, or one additional sample per event if number of samples is less than 10.

Appendix F
Cost Estimate Assumptions and Unit Rate Derivations
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

Task Description	Unit	Unit Cost	Source	Comments
Analyze for COCs				Analysis for petroleum-related COCs for each RU using EPA Methods identified. Includes collection and analysis of QA/QC samples (10%), or one additional sample per event if number of samples is less than 10.
TPH-gasoline (EPA Method 8015)	ea	\$ 45	Curtis & Tompkins, Ltd. Analytical Laboratory, June 2005 Analytical Testing Quotation	
TPH-diesel/fuel oil (EPA Method 8015 with SGCU)	ea	\$ 70	Curtis & Tompkins, Ltd. Analytical Laboratory, June 2005 Analytical Testing Quotation	
VOCs (EPA Method 8260)	ea	\$ 120	Curtis & Tompkins, Ltd. Analytical Laboratory, June 2005 Analytical Testing Quotation	
PAHs (EPA Method 8270-SIM)	ea	\$ 160	Curtis & Tompkins, Ltd. Analytical Laboratory, June 2005 Analytical Testing Quotation	
Title 22 Metals (EPA Method 6010/7740)	ea	\$ 120	Curtis & Tompkins, Ltd. Analytical Laboratory, June 2005 Analytical Testing Quotation	
Perform independent data validation	ea	\$ 41.7	Main Installation Sites FS (EKI, 2003) updated for 2006	
Input analytical results into Presidio database	ea	\$ 17.9	Main Installation Sites FS (EKI, 2003) updated for 2006	
Prepare construction report	ls	\$ 50,000	Presidio Trust experience; March 17, 2006 email from C Cooper of Presidio Trust	All Building 1065 Area CAP site work for this task will be conducted with share of cost allocated as follows: 90% to SRU A; 10% to SRU C.
Archeology monitoring	wk	\$ 4,760	Main Installation Sites FS (EKI, 2003) updated for 2006	Archeology monitoring required full time during intrusive work (e.g., excavation) and 1/3 time for minimally intrusive work (e.g., capping, well installation).
Engineering Project Management				
Design and Construction Management Services	%	9	Main Installation Sites FS (EKI, 2003)	Of subtotal estimated costs w/ contractor overhead and profit
Legal and Administrative Costs	%	5	Main Installation Sites FS (EKI, 2003)	Of subtotal estimated costs w/ contractor overhead and profit
Contingencies	%	20	Main Installation Sites FS (EKI, 2003)	Of subtotal estimated costs including construction and administrative costs.

Appendix F
Cost Estimate Assumptions and Unit Rate Derivations
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

Task Description	Unit	Unit Cost	Source	Comments
Annual Costs				
Groundwater Monitoring				
Conduct Groundwater Monitoring				
Sample well	ea	\$ 267.8	Main Installation Sites FS (EKI, 2003) updated for 2006	4 QA/QC samples will be collected and analyzed for each sampling event and analysis based on the Presidio QAPP/SAP as follows: one trip blank per cooler, one equipment rinsate blank per day, one field duplicate (10% of samples), and one MS/MSD sample (5% of samples). Includes collection of groundwater elevation data and field parameters indicated in Table 9.
Analyze water samples from wells				
TPH-gasoline/BTEX (EPA Method 8015/8021)	ea	\$ 50	Curtis & Tompkins, Ltd. Analytical Laboratory, June 2005 Analytical Testing Quotation	
Arsenic, Iron, Manganese, Aluminum (EPA Method 6010)	ea	\$ 70	Curtis & Tompkins, Ltd. Analytical Laboratory, June 2005 Analytical Testing Quotation	
Perform independent data validation	ea	\$ 41.7	Main Installation Sites FS (EKI, 2003) updated for 2006	
Input analytical results into Presidio database	ea	\$ 17.9	Main Installation Sites FS (EKI, 2003) updated for 2006	
Dispose of groundwater sampling residuals	ea	\$ 452.2	Main Installation Sites FS (EKI, 2003) updated for 2006	Per sampling event
Prepare groundwater monitoring report	ea	\$ 5,950	Main Installation Sites FS (EKI, 2003) updated for 2006	Summary of groundwater elevation data, analytical results, historical data, figures of sample locations and groundwater monitoring wells, and brief text describing any variations from sampling and analysis plan.
Cap Inspection, Maintenance, Repair	ls	\$ 3,000	Presidio Trust past bid experience	Annual cost: All Building 1065 Area CAP site work for this task will be conducted with share of cost allocated as follows: 90% to SRU A; 10% to SRU C.
Destroy groundwater monitoring wells	ea	\$ 1,785	Main Installation Sites FS (EKI, 2003) updated for 2006	26 monitoring wells will be destroyed with regulatory agency approval after groundwater monitoring program at S/GW RUs A ends.
LUC Project Management/ Administration				<u>Excavation Alternatives:</u> LUCs for co-located Soil and Groundwater RUs where excavation is implemented are assumed to be lifted when cleanup levels are met in groundwater after 5 years of monitoring. <u>Capping Alternatives:</u> LUCs for RUs where capping is implemented are assumed to be permanently maintained, and are costed for a period of 30 years per USEPA's A Guide to Developing and Documenting Cost Estimates During the Feasibility Study (USEPA, 2000).

Appendix F
Cost Estimate Assumptions and Unit Rate Derivations
Building 1065 Area Corrective Action Plan
Presidio of San Francisco, California

Task Description	Unit	Unit Cost	Source	Comments
Annual Administrative Cost of LUC	ls	\$ 1,000	Presidio Trust experience; February 28, 2005 email from C Cooper of Presidio Trust	All Building 1065 Area CAP site work for this task will be conducted with share of cost allocated as follows: 90% to SRU A; 10% to SRU C.
Annualized Cost of 5-year Review	ls	\$ 4,000	Presidio Trust experience; February 28, 2005 email from C Cooper of Presidio Trust	All Building 1065 Area CAP site work for this task will be conducted with share of cost allocated as follows: 90% to SRU A; 10% to SRU C.
Contingencies	%	20	Main Installation Sites FS (EKI, 2003)	Of subtotal estimated costs including construction and administrative costs.
Present Worth of Annual Costs	%	2.6 - 3.0	Circular No. A-94, Appendix C, Federal Office of Management and Budget, January 2006	Real Discount Rates applied to Total Annual Costs are: 1-5 years = 2.6% ; 10 years = 2.8% ; 30 years = 3.0% . Per USEPA's A Guide to Developing and Documenting Cost Estimates During the Feasibility Study (USEPA, 2000), the present worth of total estimated annual costs were calculated assuming real discount rates published in Circular No. A-94, Appendix C, President's Federal Office of Management and Budget (OMB), January 2006 (www.whitehouse.gov). The real discount rate is assumed to be equivalent to the nominal interest rate on federal treasury notes and bonds as of 2006 (adjusted to remove the effect of expected inflation) for annual expenditures over a given time period (i.e., the assumed duration for initiating and completing long-term operations and maintenance activities at each RU).

ACRONYMS AND ABBREVIATIONS

BTEX	benzene, toluene, ethylbenzene, total xylenes	QA/QC	Quality Assurance/Quality Control
COC	chemical of concern	RCRA	Resource Conservation and Recovery Act
cy	cubic yard	RU	remedial unit (area where COCs exceed cleanup levels)
ea	each	sf	square feet
ft	feet	sy	square yard
GIS	geographical information system	TPH	total petroleum hydrocarbons
ls	lump sum	VOCs	volatile organic compounds
LUC	land use control	wk	week
MRR	Master Reference Report		

Checked_____

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**Table F-1. Summary of Estimated Costs for
Capping, Land Use Controls, Groundwater Monitoring
Soil and Groundwater Remedial Units A (Building 1063)
Presidio of San Francisco, California**

Capping, Land Use Controls, Groundwater Monitoring

Task Description	Unit	Quantity	Unit Cost	Subtotal	Total ^[a]
Capital Costs					
Capping Improvements					
Mobilize contractor equipment and supplies to site	ls	90%	\$ 10,000	\$ 9,000	
Adjacent Areas Outside Building					
Sawcut asphalt	ft	200	\$ 2.6	\$ 520	
Demo asphalt and dispose and recycle at off-site facility	sf	700	\$ 1.2	\$ 840	
Repave with aggregate base and asphalt	sf	1500	\$ 2.7	\$ 4,050	
Within Building					
Inspection, air quality monitoring, seal fractures/conduits	ls	90%	\$ 5,000	\$ 4,500	
					\$ 19,000
Implement Permanent Land Use Control (LUC)					
Prepare Site-Specific Addendum to LUC Master Ref Report	ls	90%	\$ 10,000	\$ 9,000	
Share of Costs to prepare the LUCMRR for Area B	ls	90%	\$ 5,000	\$ 4,500	
Add Site-Specific LUC to Trust GIS System	ls	90%	\$ 500	\$ 450	
					\$ 14,000
Abandon Wells After Groundwater Monitoring Program Completed	ea	26	\$ 1,785	\$ 46,410	
					\$ 46,000
Design and Construction Management Services					
Engineering					
Perform general planning activities	ls	90%	\$ 11,900	\$ 10,710	
Prepare remedial design plans and specifications	ls	90%	\$ 44,625	\$ 40,163	
Prepare remedial design reports	ls	90%	\$ 44,625	\$ 40,163	
Construction observation					
Provide resident engineer	wk	1	\$ 5,950	\$ 5,950	
Provide vehicles and equipment	wk	1	\$ 1,547	\$ 1,547	
Prepare construction report	ls	90%	\$ 50,000	\$ 45,000	
Archeology monitoring	wk	0.3	\$ 4,760	\$ 1,428	
					\$ 145,000
Engineering Project Management					
Design and Construction Management Services	ls	9%			\$ 13,000
Subtotal Estimated Costs					\$ 237,000
Legal and Administrative Costs					\$ 12,000
Subtotal Estimated Costs (w/ legal and administrative costs)					\$ 249,000
Contingencies					\$ 50,000
Total Preliminary Estimated Capital Costs					\$ 299,000

**Table F-1. Summary of Estimated Costs for
Capping, Land Use Controls, Groundwater Monitoring
Soil and Groundwater Remedial Units A (Building 1063)
Presidio of San Francisco, California**

Capping, Land Use Controls, Groundwater Monitoring

Task Description	Unit	Quantity	Unit Cost	Subtotal	Total ^[a]
Annual Costs					
Conduct Quarterly Groundwater Monitoring (Year 1) ^[b]					
Sample well	ea	96	\$ 267.8	\$ 25,709	
Analyze water samples from wells					
TPH-gasoline/BTEX (EPA Method 8015/8021)	ea	36	\$ 50	\$ 1,800	
Arsenic, Iron, Manganese, Aluminum (EPA Method 6010)	ea	60	\$ 70	\$ 4,200	
Perform independent data validation	ea	96	\$ 41.7	\$ 4,003	
Input analytical results into Presidio database	ea	96	\$ 17.9	\$ 1,718	
Dispose of groundwater sampling residuals	ea	4	\$ 452.2	\$ 1,809	
Prepare groundwater monitoring report	ea	2	\$ 5,950	\$ 11,900	
					\$ 51,000
Year 1 Annual Cost (with Contingencies)					\$ 61,000
Conduct Annual Groundwater Monitoring (Years 2-10) ^[c]					
Sample well	ea	24	\$ 267.8	\$ 6,427	
Analyze water samples from wells					
TPH-gasoline/BTEX (EPA Method 8015/8021)	ea	9	\$ 50	\$ 450	
Arsenic, Iron, Manganese, Aluminum (EPA Method 6010)	ea	15	\$ 70	\$ 1,050	
Perform independent data validation	ea	24	\$ 41.7	\$ 1,001	
Input analytical results into Presidio database	ea	24	\$ 17.9	\$ 430	
Dispose of groundwater sampling residuals	ea	1	\$ 452.2	\$ 452	
Prepare groundwater monitoring report	ea	1	\$ 5,950	\$ 5,950	
					\$ 16,000
Years 2-10 Annual Cost (with Contingencies)					\$ 19,000
Cap Inspection, Maintenance, Repair (Years 1-30)					
Annualized cost to inspect and maintain cap	Is	90%	\$ 3,000	\$ 2,700	\$ 2,700
Years 1-30 Annual Cost (with Contingencies)					\$ 3,000
LUC Project Management/Administration (Years 1-30) ^[d]					
Annual Administrative Cost of LUC	Is	90%	\$ 1,000	\$ 900	
Annualized Cost of 5-year Review	Is	90%	\$ 4,000	\$ 3,600	
					\$ 4,500
Years 1-30 Annual Cost (with Contingencies)					\$ 5,000
Years 1-10 Present Worth of Annual Costs					\$ 281,000
Years 11-30 Present Worth of Annual Costs					\$ 119,000
Total Preliminary Estimated Present Worth of 30-Year Annual Costs					\$ 400,000

[a] Totals may not sum exactly due to rounding of subtotal and total costs to the nearest \$1,000.

[b] Quarterly groundwater monitoring for petroleum-related COCs (TPHg/BTEX), Arsenic, Iron, Manganese, Aluminum & field measurable redox parameters (DO & ORP) assumed for Year 1 for wells indicated in Table 9.

[c] Annual groundwater monitoring for COCs (TPHg/BTEX), Arsenic, Iron, Manganese, Aluminum & field measurable redox parameters (DO & ORP) assumed for Years 2-10 for wells indicated in Table 9 (groundwater monitoring demonstrates TPHg/BTEX and Arsenic concentrations are below cleanup levels in groundwater within 10 years).

[d] LUC is for soil and groundwater for 10 years (See Footnote c) and is assumed to be for soil only thereafter with regulatory agency approval after 10 years of groundwater monitoring demonstrates concentrations of all COCs are below cleanup levels in groundwater (See Footnote c).

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**Table F-2. Summary of Estimated Costs for
Excavation, Offsite Disposal, Groundwater Monitoring
Soil Remedial Unit A (Building 1063 Area)
Presidio of San Francisco, California**

Excavation, Offsite Disposal of Soil, Groundwater Monitoring (Recommended Alternative)

Task Description	Unit	Quantity	Unit Cost	Subtotal	Total ^[a]
Capital Costs					
Excavate Soil and Backfill^[b]					
Mobilize contractor equipment and supplies to site	ls	100%	\$ 10,000	\$ 10,000	
Excavate soil (3 cy bucket), place in end-dump truck	cy	1,100	\$ 4.20	\$ 4,620	
Dewatering	ls	100%	\$ 25,000	\$ 25,000	
Placement of oxygen release product in excavation bottom	lb	3,000	\$ 10	\$ 30,000	
Import, place, and compact backfill material	cy	700	\$ 23	\$ 16,100	
Collect soil profile samples for disposal	ea	3	\$ 30.9	\$ 93	
Disposal characterization	ea	3	\$ 185	\$ 555	
Transport and dispose of soil					
Class III	ton	790	\$ 23	\$ 18,170	
Class II non-RCRA hazardous	ton	990	\$ 35	\$ 34,650	
Class I non-RCRA hazardous	ton	200	\$ 70	\$ 14,000	
Site Restoration Outside Building					
Sawcut asphalt	ft	200	\$ 2.6	\$ 520	
Demo asphalt and dispose and recycle at off-site facility	sf	700	\$ 1.2	\$ 840	
Repare with aggregate base and asphalt	sf	1500	\$ 2.7	\$ 4,050	
					\$ 159,000
Implement Land Use Control (LUC)					
Prepare Site-Specific Addendum to LUC Master Ref Report	ls	90%	\$ 10,000	\$ 9,000	
Share of Costs to prepare the LUCMRR for Area B	ls	90%	\$ 5,000	\$ 4,500	
Add Site-Specific LUC to Trust GIS System	ls	90%	\$ 500	\$ 450	
					\$ 14,000
Abandon Wells After Groundwater Monitoring Program Completed	ea	26	\$ 1,785	\$ 46,410	
					\$ 46,000
Design and Construction Management Services					
Engineering					
Perform general planning activities	ls	90%	\$ 11,900	\$ 10,710	
Prepare remedial design plans and specifications	ls	90%	\$ 44,625	\$ 40,163	
Prepare remedial design reports	ls	90%	\$ 44,625	\$ 40,163	
Construction observation					
Provide resident engineer	wk	4	\$ 5,950	\$ 23,800	
Provide vehicles and equipment	wk	4	\$ 1,547	\$ 6,188	
Conduct geotechnical and compaction testing	wk	1	\$ 3,868	\$ 3,868	
Collect soil confirmation samples	ea	28	\$ 30.9	\$ 865	
Analyze soil confirmation samples					
TPH-gasoline (EPA Method 8015)	ea	1	\$ 45	\$ 45	
TPH-diesel/fuel oil (EPA Method 8015)	ea	28	\$ 70	\$ 1,960	
VOCs (EPA Method 8260)	ea	28	\$ 120	\$ 3,360	
PAHs (EPA Method 8270-SIM)	ea	28	\$ 160	\$ 4,480	
Title 22 Metals (EPA Method 6010/7740)	ea	28	\$ 120	\$ 3,360	
Perform independent data validation	ea	28	\$ 41.7	\$ 1,168	
Input analytical results into Presidio database	ea	28	\$ 17.9	\$ 501	
Prepare construction report	ls	90%	\$ 50,000	\$ 45,000	
Archeology monitoring	wk	1	\$ 4,760	\$ 4,760	
					\$ 190,000
Engineering Project Management					
Design and Construction Management Services	ls	9%			\$ 17,000
Subtotal Estimated Costs					\$ 426,000
Legal and Administrative Costs					\$ 21,000
Subtotal Estimated Costs (w/ legal and administrative costs)					\$ 447,000
Contingencies					\$ 89,000
Total Preliminary Estimated Capital Costs					\$ 536,000

**Table F-2. Summary of Estimated Costs for
Excavation, Offsite Disposal, Groundwater Monitoring
Soil Remedial Unit A (Building 1063 Area)
Presidio of San Francisco, California**

Excavation, Offsite Disposal of Soil, Groundwater Monitoring (Recommended Alternative)

Task Description	Unit	Quantity	Unit Cost	Subtotal	Total ^[a]
Annual Costs					
Conduct Quarterly Groundwater Monitoring for TPHg/BTEX, Arsenic & Redox Parameters (Year 1)^[c]					
Sample well	ea	96	\$ 267.8	\$ 25,709	
Analyze water samples from wells					
TPH-gasoline/BTEX (EPA Method 8015/8021)	ea	36	\$ 50	\$ 1,800	
Arsenic, Iron, Manganese, Aluminum (EPA Method 6010)	ea	60	\$ 70	\$ 4,200	
Perform independent data validation	ea	96	\$ 41.7	\$ 4,003	
Input analytical results into Presidio database	ea	96	\$ 17.9	\$ 1,718	
Dispose of groundwater sampling residuals	ea	4	\$ 452.2	\$ 1,809	
Prepare groundwater monitoring report	ea	2	\$ 5,950	\$ 11,900	
					\$ 51,000
Year 1 Quarterly Monitoring Annual Cost (with Contingencies)					\$ 61,000
Conduct Semi-Annual Groundwater Monitoring for TPHg/BTEX (Years 2-3)^[d]					
Sample well	ea	18	\$ 267.8	\$ 4,820	
Analyze water samples from wells					
TPH-gasoline/BTEX (EPA Method 8015/8021)	ea	18	\$ 50	\$ 900	
Perform independent data validation	ea	18	\$ 41.7	\$ 751	
Input analytical results into Presidio database	ea	18	\$ 17.9	\$ 322	
Dispose of groundwater sampling residuals	ea	2	\$ 452.2	\$ 904	
Prepare groundwater monitoring report	ea	2	\$ 5,950	\$ 11,900	
					\$ 20,000
Years 2-3 Semi-Annual Monitoring Annual Cost (with Contingencies)					\$ 24,000
Conduct Annual Groundwater Monitoring for Arsenic & Redox Parameters (Years 2-5)^[e]					
Sample well	ea	15	\$ 267.8	\$ 4,017	
Analyze water samples from wells					
Arsenic, Iron, Manganese, Aluminum (EPA Method 6010)	ea	15	\$ 70	\$ 1,050	
Perform independent data validation	ea	15	\$ 41.7	\$ 626	
Input analytical results into Presidio database	ea	15	\$ 17.9	\$ 269	
Dispose of groundwater sampling residuals ^[f]	ea	1	\$ 452.2	\$ 452	
Prepare groundwater monitoring report ^[f]	ea	1	\$ 5,950	\$ 5,950	
					\$ 12,000
Years 2-5 Annual Monitoring Annual Cost (with Contingencies)					\$ 14,000
LUC Project Management/Administration (Years 1-5)^[g]					
Annual Administrative Cost of LUC	ls	90%	\$ 1,000	\$ 900	
Annualized Cost of 5-year Review	ls	90%	\$ 4,000	\$ 3,600	
					\$ 4,500
Years 1-5 Annual Cost (with Contingencies)					\$ 5,000
Total Preliminary Estimated Present Worth of 5-Year Annual Costs					\$ 170,000

[a] Totals may not sum exactly due to rounding of subtotal and total costs to the nearest \$1,000.

[b] Assumes concrete slab foundation and other structural components within Building 1063 have been removed as necessary to provide access to soil for excavation as part of water tank construction project.

[c] Quarterly groundwater monitoring for petroleum-related COCs (TPHg/BTEX), Arsenic, Iron, Manganese, Aluminum & field measurable redox parameters (DO & ORP) assumed for Year 1 for wells indicated in Table 9.

[d] Semi-annual groundwater monitoring for petroleum-related COCs (TPHg/BTEX) assumed for Years 2 & 3 for wells indicated in Table 9 (groundwater monitoring demonstrates these COCs are below cleanup levels in groundwater within 3 years of excavation).

[e] Annual groundwater monitoring for Arsenic, Iron, Manganese, Aluminum & field measurable redox parameters (DO & ORP) assumed for Years 2 through 5 for wells indicated in Table 9 (groundwater monitoring demonstrates Arsenic concentrations are below cleanup level in groundwater within 5 years of excavation).

[f] These costs are included/shared under Semi-Annual monitoring for Years 2 & 3.

[g] LUC is for groundwater and is assumed to be lifted with regulatory agency approval after 5 years of groundwater monitoring demonstrates concentrations of all COCs are below cleanup levels in groundwater (See Footnotes c,d,e).

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**Table F-3. Summary of Estimated Costs for
Capping, Land Use Controls
Soil Remedial Unit C (Building 1040 Area)
Presidio of San Francisco, California**

Capping, Land Use Controls (Recommended Alternative)

Task Description	Unit	Quantity	Unit Cost	Subtotal	Total ^[a]
<i>Capital Costs</i>					
Capping Improvements					
Mobilize contractor equipment and supplies to site	ls	10%	\$ 10,000	\$ 1,000	
Adjacent Areas Outside Building					
Sawcut asphalt	ft	80	\$ 2.6	\$ 208	
Demo asphalt and dispose and recycle at off-site facility	sf	300	\$ 1.2	\$ 360	
Repave with aggregate base and asphalt	sf	300	\$ 2.7	\$ 810	
Within Building					
Inspection, air quality monitoring, seal fractures/conduits	ls	10%	\$ 5,000	\$ 500	
					\$ 3,000
Implement Permanent Land Use Control (LUC)					
Prepare Site-Specific Addendum to LUC Master Ref Report	ls	10%	\$ 10,000	\$ 1,000	
Share of Costs to prepare the LUCMRR for Area B	ls	10%	\$ 5,000	\$ 500	
Add Site-Specific LUC to Trust GIS System	ls	10%	\$ 500	\$ 50	
					\$ 2,000
Design and Construction Management Services					
Engineering					
Perform general planning activities	ls	10%	\$ 11,900	\$ 1,190	
Prepare remedial design plans and specifications	ls	10%	\$ 44,625	\$ 4,463	
Prepare remedial design reports	ls	10%	\$ 44,625	\$ 4,463	
Construction observation					
Provide resident engineer	wk	0.5	\$ 5,950	\$ 2,975	
Provide vehicles and equipment	wk	0.5	\$ 1,547	\$ 774	
Prepare construction report	ls	10%	\$ 50,000	\$ 5,000	
Archeology monitoring	wk	0.3	\$ 4,760	\$ 1,428	
					\$ 20,000
Engineering Project Management					
Design and Construction Management Services	ls	9%			\$ 2,000
<i>Subtotal Estimated Costs</i>					\$ 27,000
<i>Legal and Administrative Costs</i>					\$ 1,000
<i>Subtotal Estimated Costs (w/ legal and administrative costs)</i>					\$ 28,000
<i>Contingencies</i>					\$ 6,000
<i>Total Preliminary Estimated Capital Costs</i>					\$ 34,000

**Table F-3. Summary of Estimated Costs for
Capping, Land Use Controls
Soil Remedial Unit C (Building 1040 Area)
Presidio of San Francisco, California**

Capping, Land Use Controls (Recommended Alternative)

Task Description	Unit	Quantity	Unit Cost	Subtotal	Total ^[a]
<i>Annual Costs</i>					
Cap Inspection, Maintenance, Repair (Years 1-30)					
Annualized cost to inspect and maintain cap	ls	10%	\$ 3,000	\$ 300	\$ 300
<i>Years 1-30 Annual Cost (with Contingencies)</i>					\$ 400
LUC Project Management/Administration (Years 1-30)					
Annual Administrative Cost of LUC	ls	10%	\$ 1,000	\$ 100	
Annualized Cost of 5-year Review	ls	10%	\$ 4,000	\$ 400	
					\$ 500
<i>Years 1-30 Annual Cost (with Contingencies)</i>					\$ 600
<i>Total Preliminary Estimated Present Worth of 30-Year Annual Costs</i>					\$ 20,000

[a] Totals may not sum exactly due to rounding of subtotal and total costs to the nearest \$1,000.

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Corrective Action Plan
Building 1065 Area
Presidio of San Francisco, California

August 16, 2006

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